Compressed Air Magazine

Vol. 45, No. 11 London - New York - Paris November, 1940

TESTING BOULDER DAM EMERGENCY VALVES

ACME PHOTO

ON THE COVER

OUR cover picture is an aerial view of Boulder Dam during a recent test of the emergency outlets on the canyon walls down stream from the dam. There are six valves on each side of the canyon and each one controls the flow of water through a steel conduit 8½ feet in diameter. As the valves had not been opened since the power house was placed in operation four years ago, Bureau of Reclamation officials decided to test them. For two hours 33,000,000 gpm. of water was released. The level of the Colorado River below the dam was raised two feet, but the change in the level of Lake Mead was imperceptible to the eye. Nine outlets were open at the time this picture was taken from a T.W.A. airliner flying 7,000 feet above the dam.

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IN THIS ISSUE

THE ships that go down to the sea are not the only ones that render yeoman service. In fact, surprising as it may seem, the records for miles traveled in a year and for volume of freight transported per mile are held by a fleet of car ferries of the Pere Marquette Railway Company plying Lake Michigan waters. Next year the fleet will be augmented by the addition of the finest and largest car ferry yet built. This ship, the *City of Midland*, which is outstanding in several respects, is described in our leading article.

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OUR second article deals with the construction of two short sections of highway in Pennsylvania that involve unusually heavy rock work. Modern equipment, most of it new, is aiding the contractors to make good progress in the face of difficult natural conditions.

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THE machine tool industry of the United States is peculiar in that it consists of a number of relatively small companies, moderately financed, and privately controlled. They are, however, well managed and efficiently operated, and they lead the world in both volume and quality of production. In 1939, they exported $93,000,000 worth of tools. With exports now restricted by government control, they are bending all efforts towards accelerating the national defense program. How compressed air aids one typical concern in this enterprising group is told in our third article.

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OUR final article describes one of the most interesting sections of the great Delaware Aqueduct, the world's longest continuous tunnel. It involves not only tunneling, but also the construction of huge works for the treatment of the water that is to be supplied to New York City. Of especial interest is the description of methods used to tunnel through a zone of especially bad ground far below the surface.

Compressed Air Magazine

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Volume 45 **NOVEMBER, 1940** Number 11

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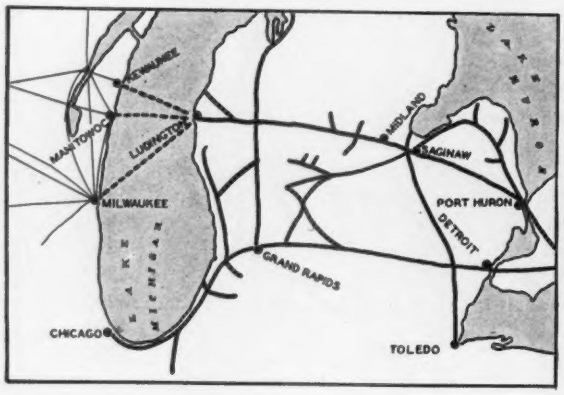
A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

CCA Member Controlled Circulation Audit.

Published by Compressed Air Magazine Company. G. W. MORRISON, president; J. F. KENNEY, vice-president; F. E. KUTZ, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y., L. H. GEYER, representative.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index

The World's Largest Car Ferry

Allen S. Park



BACK in 1874, the Flint & Pere Marquette Railroad was completed to Ludington, Mich., on the eastern shore of Lake Michigan. It shortly became apparent that it would be desirable to provide some means of transporting freight and passengers to the opposite side of the lake, and in 1875 a small, privately owned side-wheel steamer was put into service for that purpose, running between Ludington and Manitowoc, Wis. A few years later, the railroad company acquired and began operating two wooden steamers, and in 1897 it added a steel car ferry. The latter craft made it possible to transport freight and cars intact, whereas it had previously been necessary to transfer the lading to the boat and to reload it into other cars on the opposite side of the lake if it was destined for inland points beyond the ferry terminal.

During the intervening years the fleet has grown until there are now six steel car ferries plying Lake Michigan waters on three routes. In addition to the Ludington-Manitowoc run, service is maintained between Ludington and Milwaukee and between Ludington and Kewaunee, Wis. This fleet has established various imposing records for water transportation. In 1939 it carried 100,738 freight cars, 18,724 automobiles, and 60,536 passengers across Lake Michigan. Running between Ludington and Manitowoc, the *City of Flint* has traveled 100,000 miles in a year, a mark which it is claimed has never been exceeded. On the same route she and her sister ship, the *City of Saginaw*, covered 1,986,000 miles in the past ten years. It is believed that no two boats in ocean service ever had so many miles to their credit or carried so much freight in a like period.

The need for the ferry service will be readily seen upon inspection of a map of the Lake Michigan area. The distance from Buffalo to Manitowoc via Ludington is 170 miles less than via Chicago by the all-rail route. The car ferry is, in effect, a bridge connecting the railways serving Michigan with those serving the Northwest. It not only saves time and mileage but it relieves the traffic burden of the lines through Chicago, the busiest railroad terminal in the world. The Ludington-Manitowoc run is also a link in U.S. Highway 10 by means of which motorists avoid the long detour around the southern tip of Lake Michigan.

At the present time the railroad, now the Pere Marquette Railway Company, is building an additional fleet unit to help handle the rapidly increasing business between Ludington and Manitowoc. This new ship, the $2,000,000 streamlined, all-steel *City of Midland*, will be the largest and most modern car ferry in the world, and one of the fastest. She is being constructed by the Manitowoc Ship Building Company at Manitowoc, where she was launched on September 18. She will go into service in 1941.

In outward appearance, the *City of Midland* will be much different from previously built members of the fleet. She will have a single streamlined stack, and the general streamlining of the black hull will be accentuated by a wide flowing band of white on her sides from bow to stern. She will be 388 feet long between perpendiculars and 406 feet long over-all. Her beam will measure 58 feet and she will have a molded depth of 23½ feet, with a maximum draft of 17½ feet. Her gross tonnage will be 6,000 and her displacement 8,200 tons. When completed she will contain 3,000 tons of steel, 700,000 rivets, 25 miles of electrical wire,

THE LAUNCHING

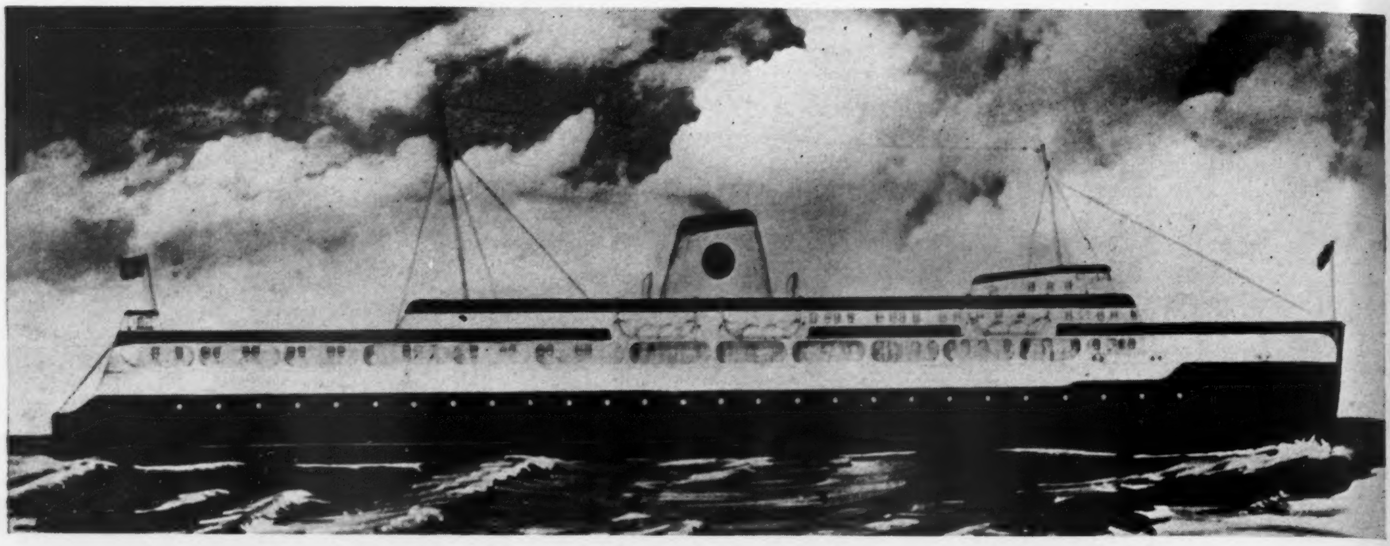
The "City of Midland," largest car ferry ever built and flagship of the Pere Marquette Railway Company's Lake Michigan fleet, sent the foam flying as she slid sidewise into the water at Manitowoc, Wis., on September 18. One visitor, a Californian touring the country, said he had made a special side trip to Manitowoc to see a vessel launched in this manner. At the top, left, Miss Helen A. Dow, daughter of the president of the Dow Chemical Company, "follows through" perfectly as she crashes a bottle of champagne against the prow of the luxurious new ship that was named for her home town in Michigan. This picture shows details of the sturdy construction of the stem to enable the boat to ride upon and break down ice. Below it, left to right, are: Miss Barbara Gilroy of Midland, Mich.; R.J. Bowman, vice-president of the Pere Marquette Railway Company; Mrs. Willard H. Dow, mother of the sponsor; G.D. Brooke, president of the Chesapeake & Ohio Railway Company; Miss Dow; Willard H. Dow, Midland industrialist; and the two Dow boys. The map indicates the savings in distance realized by the use of the three car ferry routes across Lake Michigan. The heavy lines show the Pere Marquette Railway system, and the light ones on the west side of the lake indicate connecting lines.

450 lighting fixtures, 2 miles of piping, and 6,800 feet of rail, including guardrail.

The ferry will have a carrying capacity of 34 loaded freight cars, 50 automobiles, and 376 passengers. Automobiles will make the crossing on the upper deck, to which they will be driven over a special ramp. This innovation increases the capacity for both autos and freight cars, as it will leave the main deck free for the exclusive use of the latter. There will be four railroad tracks, and cars will be run on and off over the stern. The accommodations for passengers will be the finest afforded by any ferry on the Great Lakes. There will be 74 staterooms, including twelve parlor suites having private shower and toilet facilities. Others will have hot and cold running water. Upper berths and baggage compartments will fold back into the walls when they are not required. A spacious, modernly furnished lounge, with smoking rooms for men and women partitioned from it by glass, will be provided. The dining salon, forward on the main deck, will seat 60 persons. Furniture will be of stainless-steel framework with leather upholstery that will harmonize with leather-covered doors and lightly tinted walls. The galley will be equipped for all-electric cooking and will contain a large refrigerating plant. Quarters for the officers and crew will be on the upper deck, while a radio room, with complete sending and receiving equipment, will be included in the purser's department on the main deck. Nothing has been overlooked: even special steel kennels will be available for dogs.

The *City of Midland* will be one of the safest vessels afloat, all laws and regulations of the Bureau of Marine Inspection and Navigation being complied with in her construction. Outstanding safety features include automatic sprinkler protection; an automatic fire-alarm system; modern signaling, lifeboat, and communication facilities; a gyroscope compass; and a radio compass or direction finder. In addition to the all-steel construction, the water-bottom and main hull are divided into eleven watertight compartments to safeguard against loss of buoyancy if the ship should be damaged.

The main propelling engines, two in number and each directly connected to a



AS THE FERRY WILL APPEAR

Artist's visualization of the new streamlined ship as she will look when in service next year. The boat is 406 feet long, will displace 8,200 tons, and will have a speed of 18 miles an hour. She will be capable of transporting at one time 34 loaded freight cars, 50 automobiles, and 376 passengers, and will make two round trips daily between Ludington, Mich., and Manitowoc, Wis., on opposite sides of Lake Michigan and 62 miles apart.

PNEUMATIC ROPE CUTTER

Shown here is one of the air-actuated knives used at the launching to sever simultaneously the eight 2½-inch hawsers holding the ship on the ways. A 6-inch air cylinder was suspended from the line by a semicircular yoke that also formed a guide for the cutting blade. The blade was attached directly to the cylinder piston, and did its cutting with a single upward stroke. Compressed air was admitted into the bottoms of all eight cylinders at the same instant by opening a 3-way valve. When in the inoperative position, the valve was open to the atmosphere so as to make it impossible for air to accumulate under the pistons. A receiver of ample size was interposed in the air line so that any failure of the compressors would not affect the operation of the cutting cylinders. Each was suspended by a chain, as shown, to prevent it from falling to the ground and possibly damaging the bottom connection.

cast-steel propeller, are of the vertical Unaflow poppet-valve type constructed by the Skinner Engine Company of Erie, Pa. The normal total horsepower will be 6,000 at 120 rpm., with a maximum of 7,000. Each engine has five cylinders of 25-inch bore by 30-inch stroke working under a steam pressure of 335 pounds per square inch at the throttle valve and a vacuum of 26½ inches. Steam will be generated by four water-tube boilers built by the Foster Wheeler Corporation of New York for a designed pressure of 390 pounds per square inch and to operate at 335 pounds superheated to 650°F. Coal will be used as fuel, with a mechanical stoker of the Hoffman type. Ordinarily, the boat will have a speed of 18 miles an hour. As the distance between Ludington and Manitowoc is 62 miles, it will take approximately 3½ hours for the crossing. The vessel will make two round trips, or 248 miles, a day.

In the wintertime, the ferries are subjected to extremely severe conditions, being compelled to break their way through fields of ice and to contend with ice floes. In spite of these difficulties, there has not been a single suspension of service in the past fifteen years. The answer, of course, is special hull construction. In the case of the *City of Midland*, the bow plating to a point about 75 feet aft of the stem, has a thickness of approximately 1¼ inches, or double that generally used throughout the remainder of the boat. In addition, the bow frames or ribs are of extremely heavy section, well braced, and spaced on 18-inch centers. The stem is of forged steel 11 inches wide and 4 inches thick. It projects from the bow like a knife blade and is cut away to facilitate clearing a lane through the ice, the craft riding upon it until the increasing weight is sufficient to break down any solid ice that she may encounter in her path.

It will be apparent that these conditions not only call for a stout and sturdy hull but also for the most dependable and trouble-free propulsion and auxiliary machinery obtainable. Consider, for example, what the condenser and the associate equipment serving the steam engines may have to withstand by reason of the ice. The latter may clog the inlets for the condenser circulating water, and with the supply thus shut off and the steam continuing to flow through the condenser, its tubes and shell would be heated to 225°F. or higher. Then, with water suddenly finding its way through one of the inlets, the tubes would be flushed with an icy bath while the shell would remain hot. As a result, the condenser tubes would contract and tend to pull out of the tube sheets to which their ends are anchored. Likewise, the same conditions may place an unusually severe burden on the pumps that will circulate water through the condenser, for they would be obliged to run dry at times despite the admonitions of their manufacturers that this should never be allowed to happen.

In an effort to overcome or at least to minimize these difficulties, the designers of the *City of Midland* have provided her hull with ten inlets for condenser circulating water. Normally, vessels seldom have more than two—one low in the hull that is ordinarily used, and another one at a higher level that is employed when the ship is in shallow water or in port where mud or debris might otherwise be drawn in from the bottom. The intakes of the *City of Midland* will be placed at various levels and at different points in the hull so as to insure, so far as possible, an uninterrupted supply of circulating water under the worst ice conditions.

RIVETING DECK PLATES

The 3,000 tons of steel entering into the "City of Midland" will be firmly held together by 700,000 rivets. These pictures show Ingersoll-Rand riveting and chipping hammers in use on the vessel at the Manitowoc Ship Building Company's yards.

The *City of Midland's* engines will each be served by an Ingersoll-Rand 2-pass surface condenser having 2,400 square feet of tube surface. Each is designed to handle 46,000 pounds of steam per hour. and will maintain a vacuum of 26 inches of mercury when supplied with 3,200 gpm. of cooling water at a temperature of 70°F. For the removal of air, each will have a twin-element, 2-stage, steam-jet ejector, with an inter and after condenser. Cooling water will be circulated through each condenser by a Class AFV centrifugal pump rated at 3,200 gpm. against a head of 25 feet and driven at 700 rpm. through reduction gear by a Terry 32-hp. steam turbine. Condensate will be handled by two Class AUV pumps, each rated at 110 gpm. against 90 feet of head and driven at 1,750 rpm. by an Allis-Chalmers 7½-hp. motor.

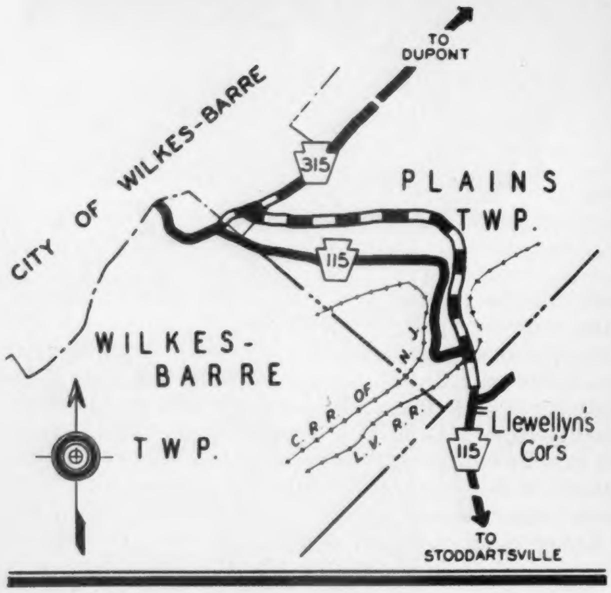
The condenser tubes, which are made of admiralty brass, are 14 feet long. They are expanded into special serrated holes in the tube sheets at both ends in such a manner as to assure a permanently tight metal-to-metal joint without resorting to excessive rolling or working of the tube material. Representatives of the railway company and of the shipyard visited the factory while the tubes were being rolled to inspect and approve the procedure. Despite the unusual service conditions to which they will be subjected, it is believed that the condensers will be safeguarded against loosening of the tubes by a feature of Ingersoll-Rand design. This consists of a self-supporting, bellows-type, expansion element in the shell that fully relieves the tubes of all expansion strains, even under extreme changes in temperature. This safety feature is always embodied in Ingersoll-Rand condensers of the type in question, but it is seldom required under ordinary circumstances because failure of water supply is an emergency that rarely if ever occurs in the average plant. However, as previously pointed out, it is likely to be of great value and economy on the *City of Midland*, where the water supply may be cut off at any time during cold weather.

The contract for the *City of Midland* was let on November 22, 1939, and the keel was laid on March 21, 1940. The Manitowoc Ship Building Company, which was awarded the contract on its low bid, also constructed the *City of Saginaw* and the *City of Flint*. Speaking at a luncheon that preceded the launching ceremonies, Vice-president A.P. Rankin of the shipbuilding company said that his concern had always tried to emulate the motto of the Newport News Yards: "We build ships, at a profit if we can, at a loss if we must, but always good ships." He predicted that this boat would uphold the company's reputation.

The Manitowoc Ship Building Company is now entering on a contract to build ten submarines for the U.S. Navy. This is the first extensive naval construction program ever awarded a Great Lakes yard and may presage additional future work to supplement the efforts of the coastal yards.

The new ferry was named for one of the important industrial centers on the Pere Marquette line, Midland, Mich., the home of the Dow Chemical Company, one of the foremost enterprises of its kind in the world. The honor of christening her was allotted to Miss Helen A. Dow, 16-year old daughter of Willard H. Dow, president and general manager of the company. The ceremonies were witnessed by a throng of 23,000 persons, including hundreds of invited guests some of whom traveled from Detroit on a special train. Among them were officers and directors of the Pere Marquette and of the Chesapeake & Ohio Railroad with which the former is allied. The principal speaker at the prelaunching luncheon served by the shipbuilding company was W.C. Hull, vice-president in charge of traffic on the two rail lines. Among the guests of honor was W.L. Mercereau of Ludington who, until his retirement in 1931, was superintendent of steamships of the Pere Marquette. He is called the "Daddy of the Fleet," as it was under his direction that much of the development of the car ferries took place.

The *City of Midland* was launched sidewise; but instead of releasing her for her trip down the ways by the traditional method, she was freed by mechanical means. Ordinarily, workmen with keen-edged axes cut the retaining trigger ropes holding the ship on the ways. In this instance there were eight of these lines, each a 2½-inch Manila hawser, and they were severed simultaneously by air-actuated knives. The blade of each was attached to a piston within a 6-inch pneumatic cylinder that was suspended from the hawser by a yoke that also served as a guide for the knife. Compressed air was admitted to all eight cylinders at the same time by operating a 3-way valve on the superintendent's stand. An equalizing tank was interposed in the air line as a safeguard against any pressure drop.



WHERE DEATH BECKONS

Signs at the top of a long hill on Route 115 near Wilkes-Barre warn of the dangers that lie ahead. Most of the fatal accidents have occurred on the curve shown at the right. It will be eliminated by the new construction. The map indicates the course of the existing highway and how a part of it will be relocated. A future contract will extend the new road into Wilkes-Barre.

TWO highway construction projects now underway in the mountainous section of eastern Pennsylvania are outstanding for the heavy rock work they include. Together they call for the expenditure of more than $1,000,000 for building 4.58 miles of concrete-surfaced roadway, which is equivalent to an average cost per mile of more than $225,000. The total quantity of material to be excavated is nearly 750,000 cubic yards, measured in place. Three-fourths of this, or 562,000 cubic yards, is rock. Cuts range in depth to more than 100 feet on the high side, and fills to 90 feet in height. One of the projects is just outside of Wilkes-Barre, in Luzerne County, and the other is adjacent to Tamaqua, in Schuylkill County. Both are in the anthracite coal belt and are relocations of existing highways.

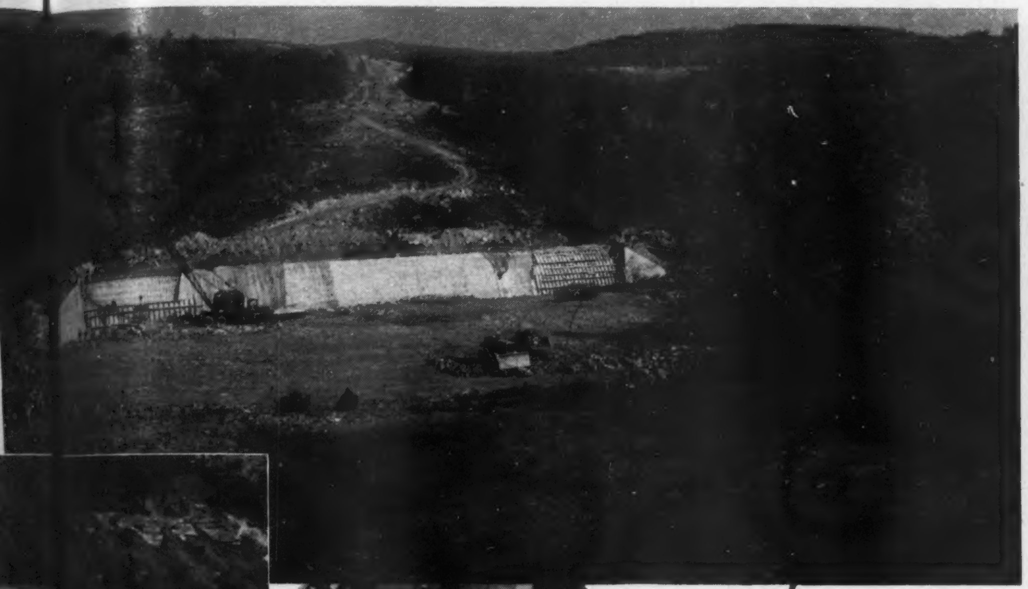
The larger and more spectacular of the two jobs is the one near Wilkes-Barre and involves a part of Route No. 115, the principal highway approaching the city from the eastward. Wilkes-Barre lies in the broad valley of the Susquehanna, which locally flows southwestward. Wyoming Mountain, a plateaulike member of the Appalachian uplift, forms the southeastern side of the valley, and the general level of its top is 1,000 feet higher than the river. Route No. 115 descends the slope of this mountain on a course that has some grades and turns that make it dangerous. One particularly bad section combines a steep pitch with a right-angle curve near the bottom and has proved to be one of the most hazardous stretches of roadway in the state. The high accident rate has led highway authorities to put up numerous and frequent warning signs: but despite these admonitions the turn has continued to be a death trap. Because of their great weight, trucks are particularly difficult to maneuver around this turn unless they have been nursed down the grade in low gear. Unfortunately, many drivers have failed to heed the signs cautioning them to do this, and, as a consequence, 38 have lost their lives on the highway.

As is commonly the case with roads built a good many years ago, the existing highway largely owes its shortcomings to the fact that it was laid out to follow the easiest and cheapest route consistent with the terrain. A watercourse, Laurel Run, descends the mountain, and the road was planned so that it would work down to this stream, then follow it until the more gently sloping ground at the base of the mountain was reached. The drop into the virtually miniature canyon through which Laurel Run flows necessitated steep grades and a sharp turn at the bottom of the canyon.

To overcome this dangerous alignment, the relocation must skirt one side of the canyon wall, work its way downward on moderate grades, and strike the stream much farther down its course. This calls for heavy cuts and deep fills, with their in-

in Roads at $200,000 a Mile

C. H. Vivian

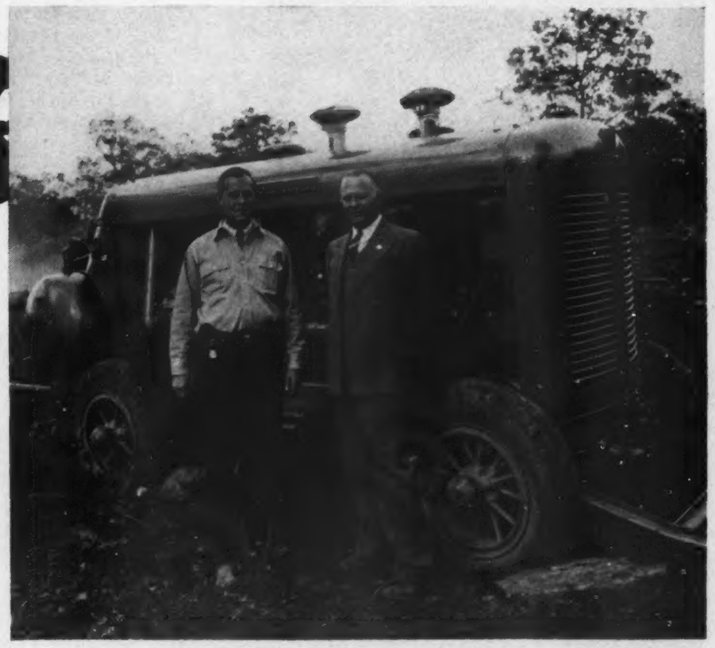


WHERE 85 FEET OF FILL WILL BE PLACED

A view from Cut No. 1 on the Wilkes-Barre job looking across the valley of Laurel Run to the hillside where Cut No. 2 will be carved. A scar on the mountain farther up and to the right shows the course of the road beyond. A portion of the 205,000 cubic yards that will be placed in the depression in the foreground has already been deposited and consolidated by rolling. The reinforced-concrete arch is 249 feet long and has a 20-foot span.

PERSONNEL

Below, in the picture at the left, is shown D.A. Kessler of Mt. Carmel, Pa., whose company is building the new road between Tamaqua and Hometown. At the right are two of the men concerned with the Johnson, Drake & Piper contract near Wilkes-Barre: Edwin Grove, left, superintendent of grading, and C.M. Benz, resident engineer for the Pennsylvania Department of Highways. They are standing in front of one of the K-500 portable compressors that furnish air for operating the rock drills.



evitable high costs. Benefits, in addition to promoting safety, will be a slightly shorter route, a speeding up of traffic, and easier driving with less wear and tear on vehicles. As an accompanying sketch shows, there will be only one curve of consequence, and this will have a wide sweep that can be easily negotiated at normal speed. The road will climb approximately 500 feet with a maximum grade of 5.88 per cent, except at the upper end where it will merge with the present route and where 800 feet of new construction will be on a grade of slightly less than 8 per cent.

The undertaking is a Federal Aid Project of the Pennsylvania Department of Highways. The work is being done by Johnson, Drake & Piper, Inc., of Freeport, N. Y., under a contract amounting to $659,000. It involves grading 3.04 miles of roadway and surfacing it with three 11-foot lanes of reinforced concrete 9 inches thick. The contracting company is allowed 230 working days in which to complete the project. Operations were started the latter part of July and are being pushed forward on a 24-hour daily schedule. The total quantity of material to be excavated will be 582,199 cubic yards, measured in place, and of this approximately 70 per cent is rock. About 90 per cent of it will come from four large cuts ranging in length from 1,100 to 2,000 feet. Three of these will be in rock and one in gravel and clay. There will be three major fills up to 2,000 feet long.

Roadbuilding of this type calls for the employment of the most modern and powerful equipment available. Reliability is also of paramount importance, especially where work goes on around the clock. Most of the loading and hauling equipment on this contract is being furnished by Walter W. Magee, a St. Paul, Minn., contractor, to Johnson, Drake & Piper, Inc., which is using its own drills, compressors, and certain other machinery. Six wagon drills—Ingersoll-Rand Type FM-2's on which are mounted heavy X-71 drifters—are utilized in the rock. Compressed air for operating them is supplied by three large portable compressors of which two are Model K-500's with oil-engine drive and air-cooled compressor ends. Broken rock is loaded by a 2¼-yard Marion 480 shovel, a 1½-yard

Bucyrus-Erie 37-B, and a Bucyrus-Erie 44-B special. A smaller shovel, a Bucyrus-Erie 19-B, is used at the tops of slopes to cast down material to one of the bigger loading units. Rock is hauled by 15 Hug trucks with 5-yard bodies.

All the cuts have been opened up to some extent, and a rough roadway that provides access to the different parts of the job has been established, but so far the greater part of the actual excavating has been done at the lower end of the contract. The first cut at that end is in gray sandstone and will be 1,250 feet long and 52 feet deep at the center line after 99,607 cubic yards of material has been removed from it. Blast holes are being drilled on 7½-foot centers to a depth of 14 feet. They are loaded with ¾ pound of Hercules gelamite for each cubic yard of rock. From 300 to 500 holes are shot at a time. The broken material is loaded into trucks by steam shovel and deposited to the eastward where a 205,000-cubic-yard fill will be made between the first and second cuts.

The latter fill will carry the roadway over Laurel Run; and to permit that stream to flow beneath it, there has been constructed at the bottom of the ravine a reinforced-concrete arch having a length of 249 feet and a span of 20 feet. Its side walls are 7 feet thick at the base, and the crown has a thickness of 15 inches. The concrete, totaling 1,754 cubic yards, was hauled from Wilkes-Barre in transit-mix trucks and handled for pouring into the forms by a truck-mounted crane. A second arch of 6-foot span was built alongside the larger one to accommodate a 24-inch pipe line of the Scranton Spring Brook Water Company that supplies a part of Wilkes-Barre's water. The fill over these structures will eventually contain 205,000 cubic yards of material and will have a maximum height of about 85 feet. All fill material is spread by bulldozers and rolled to consolidate it.

The second cut is in clay and gravel, which is being excavated and moved by LeTourneau 12-yard carryalls drawn by RD8 diesel tractors. It will be 1,100 feet long, 56 feet deep at the center line, and calls for the removal of 123,405 cubic yards of material. Some of the dirt from this cut will go into the fill over Laurel Run, and the remainder will be placed in a fill on the other side of the cut. The latter fill will be 1,650 feet long and will be made up of 81,629 cubic yards. Cut No. 3 farther up the mountainside will be 1,350 feet long, 55 feet deep at the center line, and from it will be taken 107,447 cubic yards of material. The rock is a hard-drilling conglomerate, and to break it blast holes are being drilled on 5-foot centers to a depth of 14 feet. They are loaded, the same as those in Cut No. 1, with ¾

TRANSFORMATION

Below, right, is a view looking upward along the future roadway, showing where a cut 101 feet deep on the uphill side will be made. The crude roadway, on a grade of about 30 per cent, is used to bring in equipment and supplies. The two other pictures were taken two weeks earlier. The portable compressor in the left-hand view was stationed at the top of the hill of which a section is shown with three FM-2 wagon drills at work about halfway up. Observe the ropes attached to the tops of the towers to hold the drills on the steep slope.

SCENES ON TAMAQUA CONTRACT

Four Model 315 portable compressors and four FM-2 wagon drills working in a side-hill cut from which 40,000 cubic yards of rock was removed.

pound of gelamite for each cubic yard of rock.

There will be but a short gap between Cut No.3 and the final one. The latter will be in red sandstone, with some sand and gravel at its upper end. It will be 101 feet deep on the uphill side, 63 feet deep at the center line, and involves the removal of 203,374 cubic yards of material. The rock is somewhat seamy and drills easier than that in either of the other cuts. It will be drilled on 8-foot centers and holes will be put down 30 feet.

Between the fourth cut and the juncture with the existing road is a ravine formed by Kelly Run, a tributary of Laurel Run. To provide a crossing over this depression it will be necessary to build up a fill 1,000 feet long with a maximum height of 90 feet. It will be composed of 256,403 cubic yards of material, which will be obtained from Cuts Nos. 3 and 4. Kelly Run will pas under the fill through a 10-foot-span concrete arch 362 feet long, and the road will cross it on a grade of 5.88 per cent to join Route 115. To carry the new and wider highway over the depressed tracks of the Lehigh Valley Railroad just beyond the point of merger, a new I-beam bridge will be constructed. It will have a span of 66 feet and a width of 74 feet, and will be fabricated of structural steel of which the total requirement will be 85 tons. The new road will continue beyond the bridge for 800 feet, following the present alignment and providing a transition from a 3-lane to a 2-lane highway.

Drilling for the most part is being done with Ingersoll-Rand Jackbits. Starter bits are of 2¾-inch gauge, and these are progressively reduced by resharpening to provide the smaller sizes needed with increased depth of hole. All holes are bottomed with sufficient diameter to permit the use of 2-inch-diameter dynamite cartridges. Jackbits and Jackrods are reconditioned by the Howells Mining Drill Company at its shop in Plymouth, about 7 miles from the job. All bits are hot-milled and are hardened according to the needs of the particular type of rock in which they are being used. To enable the work to proceed at night there are five portable plants for generating electric current. These consist of three Kohler units of 5,000-kw. each and of two Surelight plants, one of 1,200 kw. and one of 1,500 kw. Approximately 240 men are employed on the three shifts.

Supervision of the work is directly under C.A. Nelson and Edwin Grove. Plans for the road were prepared in the office of John L. Herber, district engineer of the Pennsylvania Department of Highways at Scranton. The department's resident engineer on the job is C. M. Benz.

The project in Schuylkill County consists of relocating 1.54 miles of State Highway 29 between Tamaqua and Hazleton. It begins at the city limits of Tamaqua and runs northward to the Village of Hometown. It is a Federal Aid Project and is being carried out under contract by the D.A. Kessler Construction Company of Mt. Carmel, Pa., on its bid of $360,872.86. At the Tamaqua end there is a reinforced-concrete bridge that is being built by the Chester Hill Contracting Company under a subcontract. Excavating was started on July 15, and by October 15 was substantially completed except for one cut near the southern or lower end. Laying of pavement was started at the northern end, and indications are that it will be finished before the coming of severe winter weather.

In the lower or southerly section, the route follows the Little Schuylkill River for nearly half a mile, gradually working higher along the western side of the valley and emerging into open country. Grades will be moderate, save at the upper end, where the road will approach Hometown on an incline of about 8 per cent. The old highway had grades as high as 12 per cent. The new roadway will be surfaced with concrete to provide three 11-foot traffic lanes, and the upper 1,000 feet of it will be widened to four lanes. At Hometown there will be a right-angle junction with Route 45 leading to Mahanoy City on the west, and

DRILL-STEEL SERVICE SHOP

All detachable bits and drill rods used on the two contracts described in this article are reconditioned in the Howells Mining Drill Company's shop at Plymouth, Pa. Shown here are a JMA Jackmill for hot-milling bits, an oil-fired furnace, and, at the right of the furnace tender, an I-R Type G Motorblower that furnishes combustion air for the oil furnace.

additional concrete will be laid to make a wide, sweeping curve. Almost opposite this junction there will be another one with a newly constructed road to Nesquehoning, which lies to the eastward.

Excavating involved a total of 166,000 cubic yards, of which approximately 95 per cent was rock. The greater portion of this was in three cuts of which the largest called for the removal of about 40,000 cubic yards. The maximum bank height of this cut is 90 feet on the uphill side. To protect the outside edge of the roadway where it is carved out of the mountainside about midway of the job, a cement-masonry retaining wall 400 feet long is being built. It will contain 1,700 cubic yards and have a maximum thickness at the base of 10 feet. The rough stone for this wall is being obtained from a cut towards the lower end of the contract.

The drilling on this job has presented a difficult problem, owing to the character of the rock formations. All the rock is sedimentary, but it varies greatly even within the confines of a single cut. Sandstones predominate, except at the lower end where there is a heavy cut through Pottsville conglomerate, an especially obstinate material because the pebbles, that are bound together by the matrix, consist largely of quartz. The strata in this section have been subjected to much folding during mountain-making eras, and in this particular area they dip steeply, sometimes almost vertically. Consequently, drill holes cross bedding planes and joints at a high angle. This, together with the somewhat fractured condition of the rock, tends to bind steels and makes it necessary to use powerful drilling equipment to avoid excessive trouble and delays. The Kessler Company is doing this, and is also drilling unusually large-diameter holes, as past experience with the rock of this region shows that this procedure reduces the number of stuck steels and is generally more satisfactory than drilling holes of conventional size. One advantage of the larger holes is that heavy charges of powder can be placed in them, thus helping to break the rock, as desired.

Eight Ingersoll-Rand Type FM wagon drills with X-71 drifter drills mounted on them are employed. Air for operating them is furnished by eight 315-cfm. I-R portable compressors of which seven are on standard steel-wheel mountings and one is on a truck. All eight drills and eight compressors were massed for operations on the largest of the cuts, while varying numbers were used in the others, depending in each instance upon the amount of rock to be removed, its character, and the room available for working. The drills have each averaged approximately 250 feet of hole per shift of seven hours.

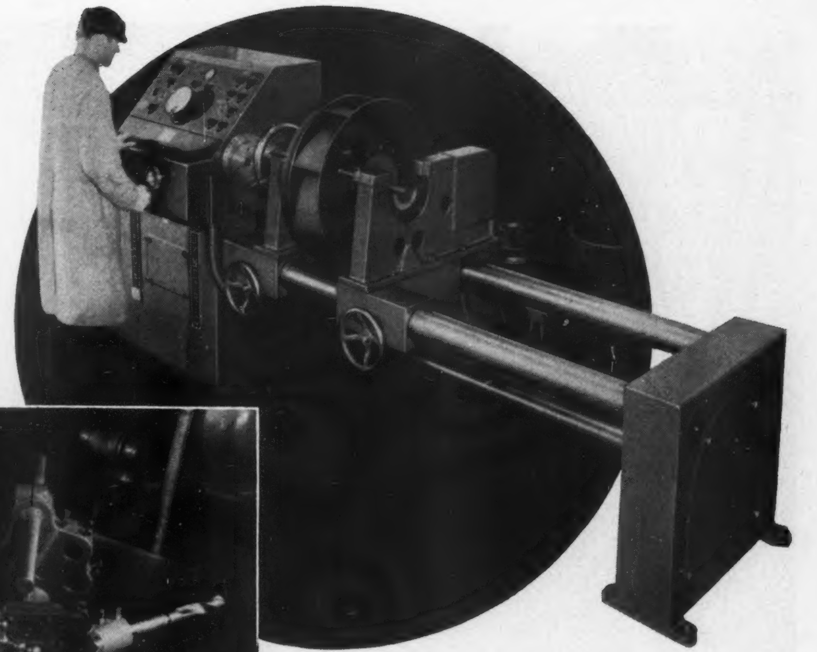
Ingersoll-Rand Jackbits and Jackrods are employed. The bits are of the standard 4-point Type 3 and the starters are 3½ inches in diameter. Holes are drilled 18 feet deep and are bottomed at 3-inch diameter. Holes are spaced 5, 6, or 7 feet apart, according to rock conditions. Jackrods are of 1¼-inch round steel. All bits and rods are reconditioned by the Howells Mining Drill Company in its shop at Plymouth, Pa., the bits being hot-milled. All new bits purchased by the contractor are 3½ inches in size, the smaller ones needed being obtained by reducing them progressively with each reconditioning. Starter bits have been used for drilling the first six feet and, in much of the ground, have started two holes each before requiring resharpening. On the average, each bit has been resharpened three times, giving four usages. Holes are loaded with 2x16-inch cartridges of Atlas 60 per cent gelatin dynamite. Broken material is loaded by three Osgood 2-yard, diesel-engine-driven shovels. It is hauled in five Athey wagons of 14 and 16 yards capacity, one 12-yard truck, and eight 8-yard trucks.

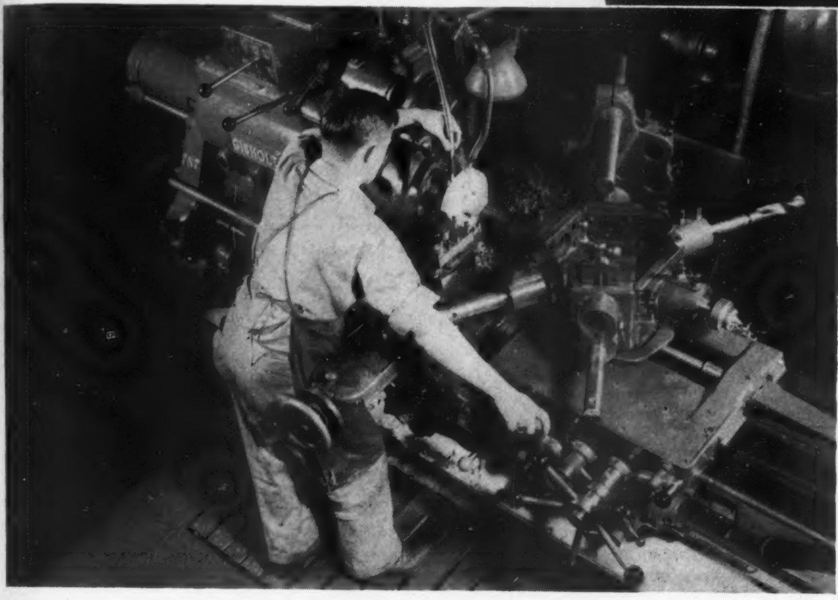
The construction of the bridge at the southern end of the contract involves changing the course of the Little Schuylkill River. The new channel will be 78 feet broad. The crossing will be 138 feet long, with a central supporting pier of brick and concrete. Two Tamaqua streets, Pine and Railroad, almost converge at the south approach to the bridge, so the structure is being made wide enough to take the traffic coming from both of them. Consequently, its width at the Tamaqua side will be 126 feet: on the opposite side of the stream it will be somewhat narrower.

The use of modern equipment, coupled with splendid organization of the working forces, has enabled the contractor to make excellent progress, and he is well ahead of schedule. Operations are conducted two 7-hour shifts a day. D.A. Kessler is personally in charge of the job, with Francis Campbell as superintendent. W.A. Reinsmith is resident engineer for the Pennsylvania Department of Highways.

Compressed Air in the "Bottleneck Industry"

Jackson Hazlewood





SOME GISHOLT PRODUCTS

The modern turret lathe (left) is a precision machine that performs a variety of machining operations. The turret, at the right of the operator, holds six tools, any one of which may be swung into position to do its work. This type of machine is used where metal has to undergo a sequence of operations, and lends itself to quantity production. New among Gisholt products is a line of balancing machines for detecting vibration in rotating parts and assemblies. Shown above is a Dynetric balancing machine being used to locate unbalance in the rotor of a blower.

CURRENT "scare" headlines in the popular press, referring to the machine-tool industry as the "bottleneck" in the pressing problem of American preparedness, place disproportionately great emphasis on the lack of skilled operators. In stressing this condition, the popular writers are guilty of an error of omission: they fail to mention the vast improvements that have been made since the World War both in product design and production methods—improvements that have resulted in a substantial increase in the effective output capacity of modern machine tools.

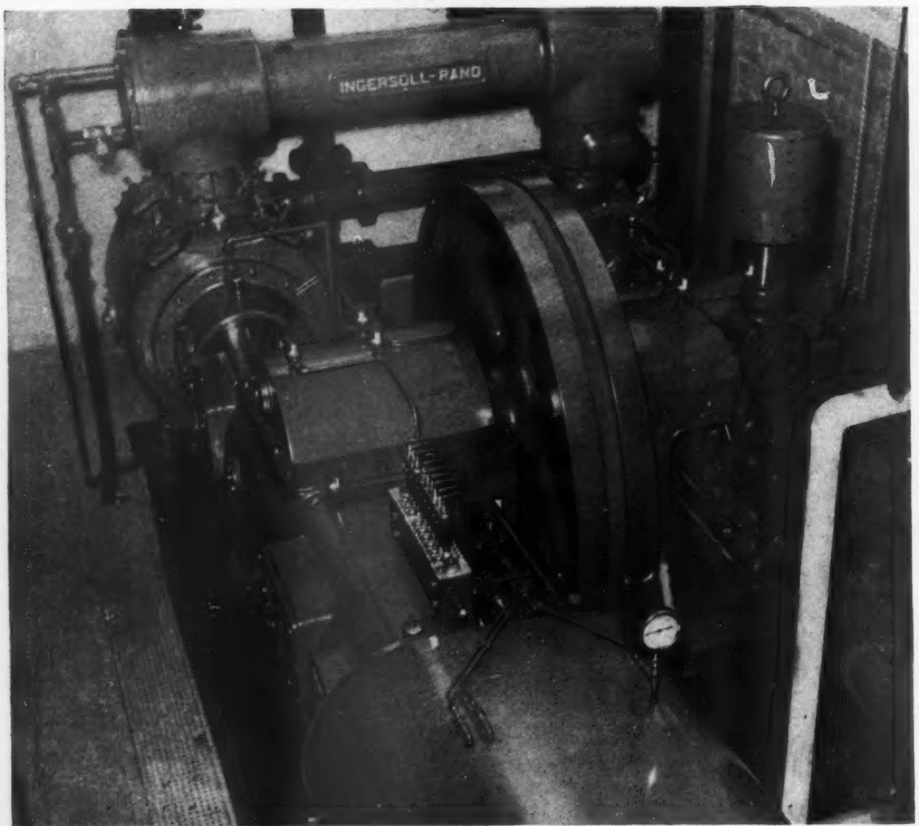
These improvements in design and production have in some cases led to great reductions in machining time. By making these reductions in time required to process a given part, some essential industries have been able to step up their plant capacities correspondingly. Even if, as in the case of certain complex war materials such as armament, this increase is restricted only to the machining phase of their manufacture, that in itself is an important advance and has a direct bearing on America's efforts towards preparedness by speeding up production. To better understand these improvements, which are typical of industry as a whole, it is necessary to know something about the background of the modern machine-tool industry—about its history, about its development and present scope.

The growth of the American machine-tool industry is closely linked with that of industrial America, dating back to the industrial revolution in the first half of the nineteenth century. The invention of the self-acting spinning jenny (generally credited with having provided the impetus for this movement) was closely followed by the development of the power-driven lathe. The application of the latter to the precision manufacture of rifles for use in the Mexican War marks the beginning of our modern machine tools. That was the first time metal was successfully shaped to tolerances sufficiently close to permit the interchangeability of parts on a scale that made mass production possible. This was succeeded by a series of "growing-pain" years during which a large number of small machine shops, many of which equipped themselves with tools of their own making, sprang up in various sections of the United States.

Sometime in the 1870's, several of those shops had established reputations as builders of machine tools that eclipsed their reputations as general machine shops. In this way the domestic machine-tool industry had its inception, and it has followed this general pattern even up to the present time. Accordingly, the business today presents an unusual picture, as compared to other American industries. It is localized in the northeast quadrant of the country, it is relatively small in point of members per dollar volume of manufacture, and it is not dominated by a few outstandingly large corporations that command the lion's share of the business.

The typical modern machine-tool plant is a closely owned (and in many cases family-managed) concern located east of the Mississippi River and north of the Ohio. It employs 1,000 men or less, and has been established more than 25 years. This is almost an exact description of the Gisholt Machine Company. Herbert Nichols, writing for a recent issue of the *Christian Science Monitor*, stated: ".......... the production of turret and engine lathes, planers, milling machines, shapers and screw machines constitutes the heart of the industry, bounded on the east by Pratt & Whitney, on the west by Gisholt,......." The latter is located at Madison, in the center of Wisconsin's famed resort area, a distinct advantage from the standpoint of the caliber of its personnel and their work.

The company normally employs 800 men, and these are drawn mainly from the permanent residents of Madison—"The Four-Lake City." Because Gisholt is a recognized leader among the comparatively few Madison industries, it attracts a high type of shop worker who usually elects to make his job with Gisholt a lifetime career.



The natural result is an older "craftsman" type of worker—a family man who takes pride in his work, his home, and Madison. Within a few blocks of the plant are Lake Monona on the south and Lake Mendota on the north, both famed for the swimming, fishing, and sailing they afford in summer and the skating and iceboating in winter. Moreover, Madison is the capital of Wisconsin and the home of its fine university—a combination that provides better-than-average attractions and amusements, including theaters, lectures, athletic contests, etc.

Gisholt is an outstanding example of successful family management. Founded in 1889 by John A. Johnson, it takes its name from the original Johnson estate in Norway, Gisholt, which means sunny woods. Since the death of the founder, three of his sons have successively served as president of the company, and a fourth as treasurer. The youngest, Hobart S. Johnson, recently retired from the presidency to become chairman of the board of directors. His oldest son, George Johnson, is now president, and another son, Stanley Johnson, is a vice-president, these brothers constituting the third generation in active management. Under the guidance of the Johnson family,

HOW COMPRESSED AIR AIDS MANUFACTURING

Compressed air is used in virtually every step of the Gisholt manufacturing procedure, its services ranging from blowing away chips from metal turning machines to operating tools and machines that save time and money in many fields of application. The pictures below, left to right, show Ingersoll-Rand sand rammers, chippers, core breakers, and multivane grinders in the foundry. Above is a view taken from the steam end of the new Type XPV compressor of 960-cfm. capacity that supplies the plant's normal air requirements. A smaller I-R machine that carried the load for 30 years now serves as a standby and to meet peak demands. Part of an HM-2 aftercooler, through which the air is passed for the removal of moisture and oil, is visible against the wall at the far end of the compressor.

the company has served American industry for more than half a century, establishing an enviable reputation for leadership in the matter of its personnel-betterment programs, as well as in the excellence of its products—turret lathes and automatic lathes. In recent years a companion product, balancing machines, has been added to the line, and of these some of the latest models were developed in conjunction with the Westinghouse Electric & Manufacturing Company.

All these machines are manufactured in a plant composed of a number of modern structures grouped around an air-conditioned administrative office building and having more than 10 acres of floor space. The plant is laid out in a manner that necessitates a minimum of trucking and is almost entirely self-contained. It supplies all its own electricity, steam, and compressed air; it machines virtually all its own parts for assembly; it makes all its own patterns and gray-iron castings; and it assembles, tests, and ships all its products. The wisdom of the company's doctrine of self-sufficiency, dictated in large measure by its location, was effectively demonstrated during the last great war when a part of its facilities were devoted to the manufacture of 4.7 field artillery for the government, thus giving ample proof of its capacity to serve the nation as a precision manufacturer. In recognition of this it received governmental citations for meritorious service.

Gisholt's products today comprise nine different models of turret lathes ranging in capacity from 1½-inch bar stock to 12¼-inch spindle bore, two types of automatic lathes, a static balancing machine, and three distinct types of Dynetric balancing machines. The latter are designed for locating and measuring any unbalance in rotating parts from a few ounces in size (such as the rotor of an electric razor) up to several tons (such as the armature of a diesel-electric motor for a modern streamliner).

It is interesting to note the importance of the role compressed air plays in the manufacture of these lathes and balancing machines. The extent of its use is indicated by the recent installation of a new Ingersoll-Rand steam-driven Type XPV compressor rated at 960 cfm. at a pressure of 90 pounds per square inch. This unit supplements a steam-driven Imperial Type 10 of the same make and rated at 640 cfm. The older machine serves as a standby not only in case of breakdown but also overload and operates as efficiently today as it has in the course of its 30 years of active service. Frequently the demand for air necessitates running it in conjunction with the new compressor.

The air is distributed among three buildings and put to typical uses, as follows: In the machine shop, of which the power house is an integral part, air is piped to each machine where a flexible hose and nozzle allow the operator to clean chips from the work, as well as from the machine ways and other highly finished delicate parts. In addition, it serves to actuate air chucks on many of the machines, to retract the platen on Gisholt Simplimatic automatic lathes, and to operate a newly developed type of tailstock on Gisholt No. 12 hydraulic automatic lathes.

In the foundry across the street, where all the castings are made, are found such familiar air-driven equipment as International molding machines, Ingersoll-Rand sand rammers, core breakers, and chippers and grinders for cleaning the finished castings. Pneumatic Sterling sanders also are utilized for finishing off the filler used in smoothing rough castings. In the assembly plant, beyond the foundry, the first local application of compressed air is noticed upon entering the building: the double doors are air operated. Along the assembly line there are frequent air outlets, thus permitting the liberal use of portable grinders. On the test floor at the end of the assembly line, where each machine is run under the customer's actual service conditions before shipment, air is piped to each machine and performs the same work that has already been described in connection with the machine shop.

After the operating test has been completed, the machine is moved to the paint booth, where air is required for paint-spraying. From there it is transferred to the shipping department, where it is carefully boxed. The crate is built around the unit on a 4x4-inch framework securely braced by stretcher bolts. Air augers assist in this work. A deVilbiss paint-spray gun is also employed to coat all exposed machine parts with slushing oil before packing. Obviously, the use of compressed air is an important and basic factor at every stage of manufacture, and without its time- and labor-saving benefits, production problems in the machine-tool industry would present an even more acute bottleneck in today's preparedness program.

Photos by Thomas J. Barbre

THE mechanical rock drill does so much work at such a low cost that hand drilling is fast becoming a lost art. In various western mining districts, however, the traditional hand-drilling contests that formerly featured holiday celebrations are being maintained. These pictures were taken at Boulder, Colo., during the annual miners' Pay Dirt Pow Wow on Colorado Day, August 7. That date is the anniversary of Colorado's accession to the union in 1876, and is observed as a state holiday.

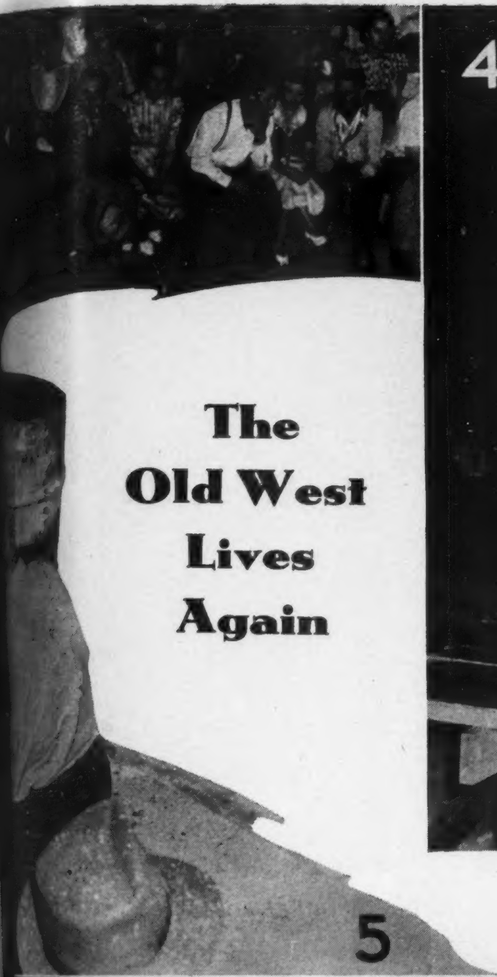
There are two classes of rock-drilling competition—single-hand and double-hand, or "singles" and "doubles" in the miner's parlance. Drilling is done in granite, all contestants in each class using the same block of rock. The drilling period nowadays is generally ten minutes, although the oldtimers always stayed "on the rock" for fifteen minutes.

The pictures of double-hand drilling show Arch Walker and Edward Saunders of Boulder taking their turn. In No.1, Walker is striking and Saunders is holding and turning the steel, while the third man, called the "swamper," is feeding water into the hole through a small rubber tube. In No.2 Saunders is striking while Walker is pulling a dulled steel from the hole and making ready to insert a sharp and longer one. This is done without missing a blow.

The team members alternate in striking and holding the steel, changing every 30 seconds. No.3 shows them changing. Walker, on the right, is finishing his period of striking while Saunders has risen to his feet and picked up his hammer. During

3

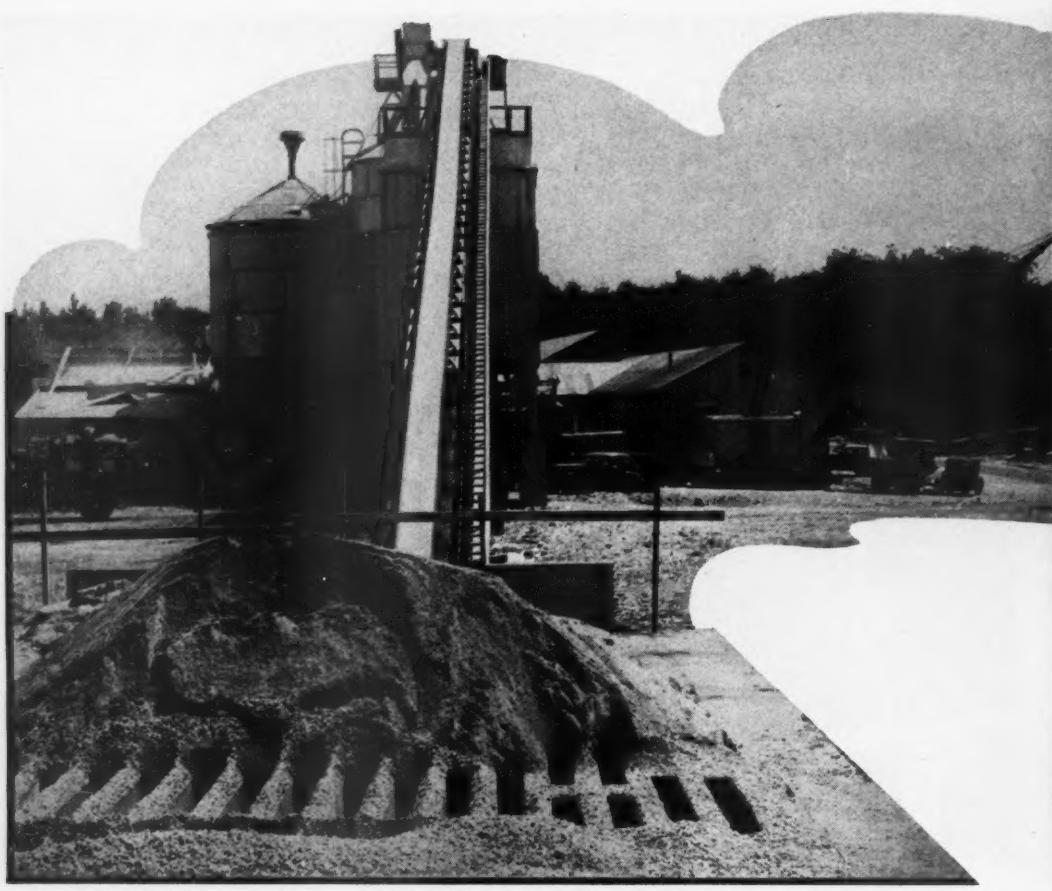
The Old West Lives Again

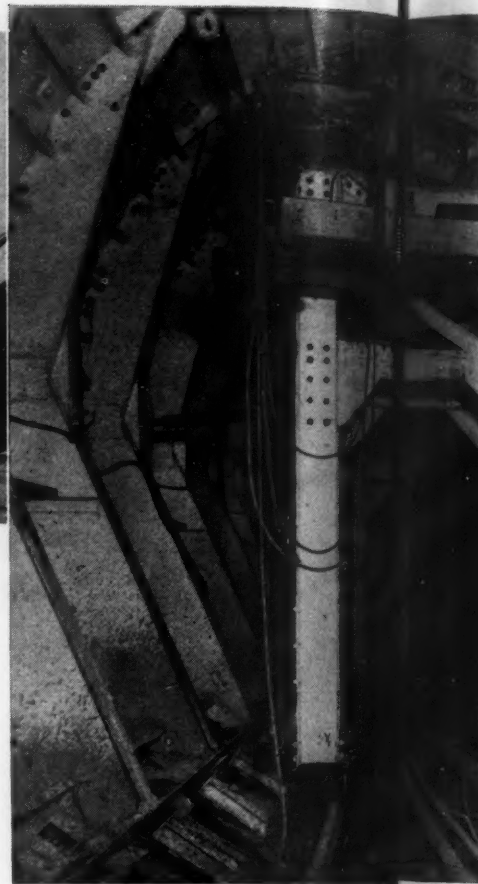


this interval of shifting, the steel is struck several blows with no one holding it, and the sequence of blows is continued without a break.

No.4 depicts the end of the grueling 10-minute period. Saunders, on the left, is plainly near exhaustion, yet his greatest interest is in looking at the steel to estimate how far it has penetrated the rock. His partner is leaning on his hammer for support. The men use 12-pound hammers, and a good team strikes from 60 to 90 blows a minute. Leading the group mounting the platform is a judge, who is holding a tape measure with which he will ascertain the depth of the hole. The tape showed 23½ inches, which was 2½ inches less than the leading mark of 26 inches set by George and Mickey Coughlin, cousins, of Sugar Loaf, Colo. Walker and Saunders won the doubles contest during the past summer at the Golden Gate International Exposition in San Francisco. In the Boulder contest they labored under a handicap, one of Saunders's hands having been struck by a hammer during the first 30 seconds. Although painfully hurt and hampered, he continued.

No.5 shows Frank Eckert, one of six contestants in the single-jack contest, holding and turning the steel with his left hand while wielding the hammer with his right hand. This contest was won by Fred Dopp of Jamestown, Colo., perennial champion, who drilled 14½ inches in the 10-minute period. Now 56 years old, Dopp has been drilling for 36 years and has been defeated only a few times.





A $21,000,000 Contract on the Delaware Aqueduct

*Everett H. Hatch**

THE manysidedness of the work being done under Contract 306 of the Delaware Aqueduct makes that section of the vast undertaking of more than ordinary interest to the engineering profession and to the millions of people of the City of New York that are to be the beneficiaries. The contract was awarded Associated Contractors, Inc., August 4, 1938, on a bid of $21,333,333.33. This is the largest sum yet assigned any part of the aqueduct work and indicates the magnitude of the job to be done. It embraces the driving and lining of 6.6 miles of tunnel and the rearing of a number of large and somewhat complex surface structures—some monumental and at least one that will be spectacular in its service.

All the operations are at or near the Kensico Reservoir, created originally as an essential feature of the Catskill Water Supply System and having a capacity of 29,000,000,000 gallons of water—enough to supply the Metropolis for a month or more should the tributary aqueduct be shut off for any reason. The reservoir and the Catskill Aqueduct leading to and from it have been in use continuously for 25 years, and during that period the latter has not been drained for inspection and repair. The Delaware Aqueduct has been planned to relieve this situation by delivering water to the Kensico Reservoir from another area of the Catskill Mountains, thus insuring an unfailing flow to that storage basin even though the Catskill Aqueduct be shut off temporarily. In addition, the facilities now under construction by Associated Contractors, Inc., will make it possible not only to transmit to the reservoir a large volume of water from the upper areas of the Croton Hills but also to detour water flowing toward it and to keep it going through the Delaware Aqueduct without entering the reservoir at all. The plan of the new aqueduct is one that will afford the greatest measure of operating flexibility and at all times assure the city an abundant supply of water.

The hidden tunnel work traces a course like an immense letter Z within a circle that has its center at the Kensico Reservoir, and it begins 6,480 feet north of that basin and runs approximately south to Shafts 17 on the east shore. At that station the tunnel drops abruptly to a depth of 1,022 feet to cross beneath the reservoir to Shafts 18 on the west shore. Downtake Shaft 17 and Uptake Shaft 18, with the deep connecting tunnel section 12,480 feet long, form the by-pass by which Delaware Aqueduct water may sidestep the reservoir. Keeping on the same compass course, the tunnel extends westward 9,470 feet to Uptake Shaft 19 at the projected site of the Eastview filter beds for which a preparatory connection chamber will be constructed. Downtake Shaft 19 will receive water near its top either from Uptake Shaft 19 or from the filter beds after the water arriving by Uptake Shaft 19 has been purified. Falling into Downtake Shaft 19, the water will enter a tunnel section 6,560 feet long that also has been driven by Associated Contractors, Inc. From the northernmost limits of the contract to Shafts 18

*General Superintendent underground operations, Associated Contractors, Inc.

the tunnel, after being lined with concrete, will have an inside diameter of 15 feet, and from Downtake Shaft 18 to the limits south of Shafts 19 the lined tunnel will be 19.5 feet in diameter. It will be circular in section throughout.

At Shafts 17, the uptake, which is 320 feet deep and 15 feet in diameter, will raise the water to a large gate chamber within a superstructure which also will house a coagulating plant. The gate chamber of this influent station will be arranged either to direct the arriving water into the reservoir through an outlet channel or to pass it immediately to the upper end of the downtake shaft which will convey it to the by-pass tunnel beneath the reservoir. Should a cloudburst or lesser but heavy rainfall in the mountains cause the water reaching the Kensico Reservoir from the Rondout Reservoir to become muddy, then alum and lime will be thoroughly mixed with it by mechanical and structural means before it is discharged into Kensico Reservoir. These chemicals will induce coagulation and precipitation of the suspended solid matter while the water moves 5 miles through a directed channel on its way toward the Delaware Aqueduct intake at the effluent station on the west shore where the gate chamber and control house are located at the top of Shafts 18. No trace of the lime or alum will be left when the water reaches the effluent station.

Before the water from the reservoir or from Uptake Shaft 18 is delivered to nearby Downtake Shaft 18, it will first be passed through Kensico Aerator No.2 now under construction adjacent to the station at Shafts 18. The two shafts at each of the three stations are close to each other and housed within the control structure at each of those points. The purpose of the aerator is to liberate entrained gases, oxidize objectionable organic matter, and disintegrate the major percentage of microörganisms that might be contained in water held for some time in storage. The treatment does away with odors and unpalatable tastes, and the addition subsequently of oxygen imparts sparkle or life to the water.

CONCRETING OPERATIONS

Concrete for lining the entire 6.6 miles of tunnels is batched at a central plant (top left) located above ground near Shafts 18. It is transported in 6-yard transit-mix trucks and dropped down the shafts through 10-inch pipes. Underground it is carried in agitators mounted on the running gears of muck cars. Curbs and inverts are poured first, and then rails are laid for a jumbo (top center) that moves the side-wall and arch forms and also lifts the agitators for dumping their contents into the placing machines. A lined section of 15-foot tunnel is shown immediately above. The view at the left shows the twin headframes over Shafts 19 that have their hoists mounted on top of them. In the foreground is a cast-steel arc that is used at a bend in the line carrying concrete to a form from the placing unit. The arc withstands the erosive action that would soon wear out a flexible pipe. Short lengths of drill steel are inserted in the holes to take the worst of the abrasion.

DRILL CARRIAGE

Rear end of a combination drill jumbo and cherry picker, showing a car of drill steels being lifted to the upper working platform. The jumbo runs on rails spaced 9 feet 8 inches apart.

Kensico Aerator No.2 will be capable of treating 1,200,000,000 gallons of water every 24 hours. It will be equipped with approximately 3,500 nozzles, and these will spray the water into the air and sunshine and otherwise vigorously agitate and splash it before returning it to underground channels that will pour it into Downtake Shaft 18 for the 13.6-mile final run to Hill View Reservoir just outside the northern boundary of New York City. The structures at Shafts 18, known as the effluent works, will be truly imposing in their proportions, and together with the other visible structures will constitute about 40 per cent of the work under Contract 306. It is not possible to describe them here.

The immediate purpose is to deal with the tunneling activities that have only recently been finished by holing through the by-pass tunnel at Uptake Shaft 18. All six of the shafts were sunk under a previous independent contract, and only four of them were utilized for tunnel driving. Uptake Shaft 17 was used to push the 6,480 feet of tunnel northward, and Downtake Shaft 17 served as the starting point for the single heading by which the by-pass tunnel was advanced under the Kensico Reservoir. From Uptake Shaft 19 was driven, with a single heading, the 9,470-foot section that connects with Downtake Shaft 18, and from Downtake Shaft 19 was driven, also with a single heading, the 6,560-foot section which terminates at the southernmost limits of the work of Associated Contractors, Inc. No tunneling was done from Shafts 18 because a deep crater had to be excavated there behind an extensive cellular cofferdam and dikes to exclude water from Kensico Reservoir. In this crater the foundations and substructures of the gate chamber of the effluent station and Kensico Aerator No.2 have been under construction for some time.

Uptake Shaft 17 is provided with a headframe 102 feet high surmounted by a hoist house, while that above Downtake Shaft 17, which is deeper, is 10 feet higher, is equipped with separate sheaves for the skip and the man-and-material cage, and its hoist is housed on a slope to the rearward. This hoist is driven by a 500-hp. motor, and the speed of the cables is 750 feet a minute. The 10-yard skip dumps automatically into a 140-yard hopper which loads the muck into trucks at the ground level through an air-operated gate. The headframe at Uptake Shaft 17 has a man-and-material cage and a counterweight, but instead of a skip makes use of a muck car that is lifted to a platform from which it can dump into the disposal hopper. Its hoist is of 400 hp. and the line speed is 600 feet a minute. The two 102-foot headframes at Shafts 19 are alike. They have cages and muck skips similar to those at Downtake Shaft 17, but the hoists are at the top of the structural-steel towers.

At each of the two tunnel-driving bases there are a compressor plant, with two machines each of 2,250-cfm. capacity, and a blower plant. That for the 15-foot tunnel sections driven from Shafts 17 can furnish 10,000 cfm. of air, while the blowers at Shafts 19 for the 19.5-foot sections can each supply 14,000 cfm. Ventilating air is carried through 26- and 28-inch vent pipes —the larger units serving the 19.5-foot sections. This piping was extended to within about 75 feet of each heading. Following a shot, the gases were thus sucked out; and during the half hour of this action the water line was connected to the air-supply line to blow spray right up to the face.

Tunneling was started from Uptake Shaft 19 on December 22, 1938, and at Downtake Shaft 19 about two weeks later. At Downtake Shaft 17, work on the by-pass tunnel was begun on May 21, 1939, and holing through took place during the first week of August of this year. Throughout the latter section the advance averaged 32.7 feet each 24 hours. The line of the by-pass ranges in depth from 1,022 feet at Downtake Shaft 17 to 1,024 feet at Uptake Shaft 18; and this was required so as to underrun a known area of disintegrated rock that lies beneath the Kensico Reservoir. To reach the area of assumed sound rock, Associated Contractors, Inc., had to deepen Downtake Shaft 17 and Uptake Shaft 18, sunk under a previous contract, 100 feet and more before starting on that section. Although several lesser faults were believed to intercept the line of the by-pass tunnel, still it was driven successively through formations of Fordham gneiss, Inwood limestone, and Manhattan schist without serious difficulties or troublesome water. As a precautionary measure, the arch was supported throughout with steel.

Before operations could be undertaken at any of the six shafts it was necessary to unwater them. In driving the tunnel sections, the practice was to advance the whole face at each round. In case of those of 15-foot finished diameter, the excavation was about 18 feet 10 inches in diameter except where the rock had to be supported, when it was 20 feet 4 inches. A drill round required from 60 to 68 holes, and the biggest advance in a single week, including the placing of steel for the arch, was 271 feet. The 19.5-foot tunnel sections were excavated to 23 feet 8 inches where the rock did not need support and to 25 feet 2 inches where it did. From 75 to 90 holes were drilled for each round, and the greatest advance in a week was 236 feet, the arch being supported with steel throughout. From start to finish of those sections, the average footage was 24.4 each 24 hours.

At each heading there were in service a combined drill carriage and cherry picker that traveled on 9-foot-8-inch-gauge track, and a Conway 75 mucking machine. A muck train was usually made up of six 6-yard Koppel side-dump cars; and the cherry picker, equipped with a 2-drum hoist operated by a 25-hp. high-torque motor, shifted the empties while mucking was in progress. The trains moved on track of 3-foot gauge, and each was hauled by a Goodman, 10-ton storage-battery

locomotive, the charging stations being at the surface.

The jumbo used in driving the by-pass tunnel normally carried nine drills at its forward end—five on the two side posts and in the lower center and four on the top platform, and two were mounted on the rear side uprights to drill holes in the side walls for the underpinning of the steel-arch support. The explosive charge for each round varied from 500 to 550 pounds of 40 or 60 per cent powder. Drilling time for the 15-foot face was from 2 to 2¼ hours; mucking time was of about the same duration; and a half hour was allowed for clearing the gases from a heading after a shot. Work was carried on in three shifts 24 hours a day. Present-day practice prevailed in safeguarding loading and shooting; and the firing station was from 1,500 to 2,000 feet back from a heading. In the 19.5-foot tunnel it took from 2½ to 3 hours to drill a round, about 4 hours for mucking, one hour for loading and firing, and ventilating after a shot continued for 30 minutes. The crew of a jumbo varied from 17 to 25 men, according to the size of the heading and the number of drills in service.

The drill steels used ranged from 4 feet to 14 feet 10 inches in length, and the holes were started with 2¼-inch bits and finished with 1⅝-inch bits. At each of the four bases or shafts from which tunnel-driving was done there were a drill doctor and a surface blacksmith shop where the steels were sharpened and, loaded on a car, sent down a shaft and run directly up to a heading. At the peak of operations all four headings were being pushed ahead simultaneously.

When the 19.5-foot tunnel section extending southward from Downtake Shaft 19 had been advanced approximately 2,060 feet, the contractors encountered the first stage of the most serious setback in their work. That was on May 17, 1939, and not until December 10, after a hard, persistent, and diversified attack, was the succeeding 152 feet of bad ground penetrated. Up to that May day, the heading had progressed in the usual manner, the only exception being an occasional inflow of water varying from 100 gpm. to 630 gpm. That water, however, was effectively controlled and reduced to relatively small amounts by grouting.

IN CHARGE OF TUNNELING

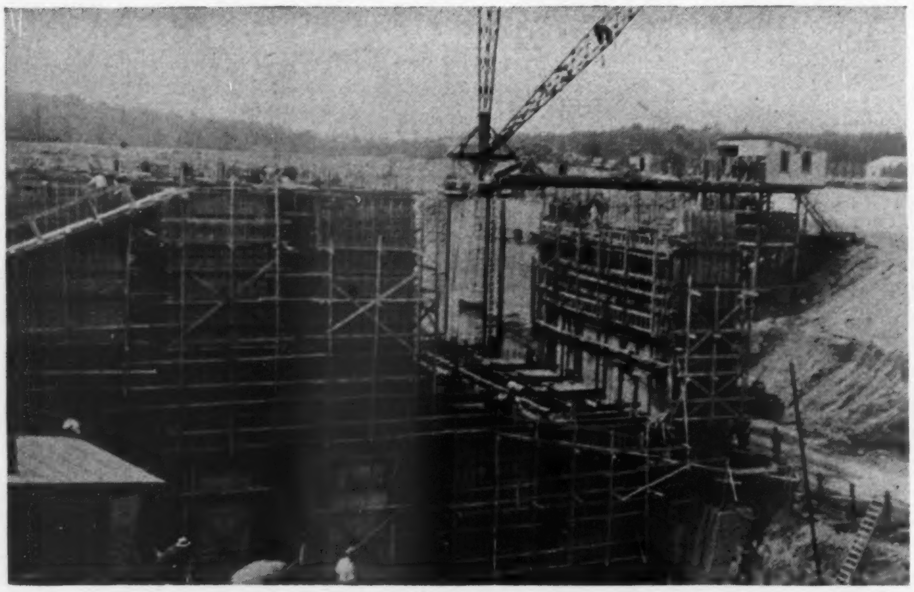
Upper left- Shift bosses at Shafts 17, left to right: G.C. Lawyer, E.C. Tufts, M.L. Kelley, M. Brown. Upper right- Shift bosses at Shafts 19, left to right: D.E. Cheff, A. Helmick, J. Snyder, W. Harrison. Lower picture- Left to right: Clyde Turner, superintendent at Shafts 17; Everett H. Hatch, general superintendent of underground operations and author of this article; Lester Huntington, superintendent at Shafts 19.

The rock encountered had been mostly hard Manhattan schist which tended to break out in sizable blocks because of numerous joints and necessitated the use of steel roof support. Two beds of limestone—one 50 and the other 100 feet thick—had been penetrated a little way back from the point where the main trouble started. When the heading reached Station 3921+38, the excavators met decayed schist of the consistency of coarse-grained sand at the bottom of the west side, a probable indication of a stretch of bad ground ahead. Drilling and blasting were suspended, and a small, timbered exploratory drift was driven about 10 feet at the troublesome side. The shifting nature of the ground was soon disclosed by the buckling of some of the ribs of the steel roof support; and shortly afterward water poured in from a joint in the hard-rock face on the east side of the tunnel and quickly increased to a volume of 750 gpm., bringing in much fine and medium sand. That inflow, which lasted about two days, reached a maximum of 1,500 gpm.; and for many weeks following, the leakage was as much as 700 gpm. Subsequently it dropped gradually to 300 gpm.

That first inflow carried into the tunnel from 40 to 50 carloads of muck; and much the same thing occurred later whenever an exploratory diamond drill hit a pocket. The hydrostatic head in the rock had a maximum pressure of 195 pounds, by gauge. The first inrush was not brought under control until May 20, and by that time the floor of the tunnel was flooded 3 feet deep and trips between the shaft bottom and the heading were made in rowboats. Eight pumps, with a combined rated capacity of 2,500 gpm., were provided to deal with the inundation; but because of the limited capacity of the installed discharge line in the shaft it was not immediately possible to pump more than 1,350 gpm.

When the water had been lowered to the level of the tunnel floor the contractors erected a concrete bulkhead 14 feet thick 28 feet back from the heading and filled the intervening space with concrete and grout blown in through 2- and 6-inch steel pipes embedded in the bulkhead. The water that came in through the face was carried rearward through the bulkhead by a 15-inch steel pipe and four 6-inch pipes. To facilitate diamond drilling and grouting, twelve additional 4-inch and thirteen 2-inch pipes were installed. All the pipes mentioned extended from the face of the bulkhead to the original heading face, except a number of the 2-inch pipes which were used to seal the bulkhead and were fitted with gate valves to control the water and the grout.

Grouting was started May 26, 1939, and continued without cease until June 12. By that time 6,400 cubic yards of fluid grout, requiring 15,900 barrels of cement, had been forced into the space between the



KENSICO RESERVOIR EFFLUENT WORKS

About 40 per cent of the work under this contract consists of erecting huge effluent works for aerating the water at Kensico Reservoir before it is sent on to Hill View Reservoir just outside of New York City. In the lower picture is seen a floating template used in driving the sheet-steel piles for the cellular units of a cofferdam behind which was excavated a craterlike pit in which the structures are being built. The upper view shows some of the monumental headworks under construction.

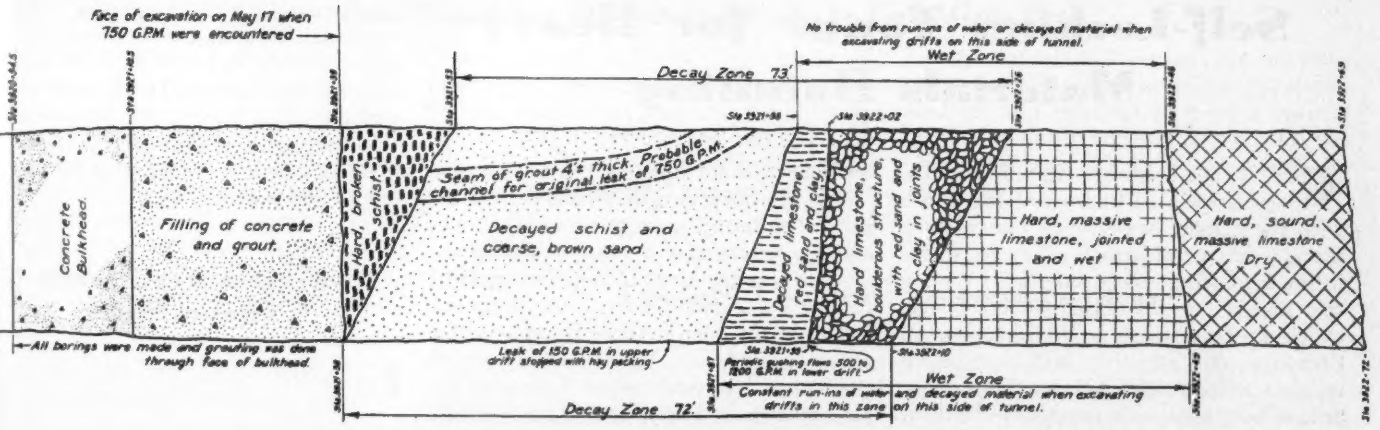
bulkhead and the heading. Test borings were then made through the bulkhead and the grouted area ahead. The maximum penetration was about 215 feet, and that drill hole was finished on July 1. The borings revealed a decayed zone approximately 60 feet thick beyond the hard schist, and from that point onward there was a decayed zone composed of broken and jointed limestone from which the drill holes allowed water to escape at a rate of about 200 gpm. and at pressures ranging from 150 pounds to 165 pounds per square inch.

Manifestly the tunnel could be advanced through the bad ground only by consolidating the broken material with grout; and two pumps were utilized to force it in through all the exploratory holes which were not interconnected. For eight days these operations were continued, and in that period 3,100 cubic yards of grout was injected—7,820 barrels of cement being used for the purpose. The proportions of the mixture ranged from one bag of cement to from 7 to 20 gallons of water, and the pressures reached as high as 900 pounds per square inch. Subsequent test borings proved that the decayed material and the broken limestone back of the bad zone had been cemented; and when drill holes were opened to permit the escape of water, the maximum discharge did not exceed 550 gpm. By the end of September, 1939, the flow had dropped to an estimated 150 gpm.

Before the stage just mentioned was reached, the contractors had begun to drive two small drifts at the bottom of the tunnel section, and then gradually expanded those operations. As these drifts advanced, concrete side walls were placed in each, and when these were up to a point a little above the springing line of the prescribed tunnel section, a top center drift and wing drifts were laboriously driven and braced so that the steel support members for the roof could be assembled and secured. In the decayed zone, much of the material was excavated with picks and shovels and with pneumatic bull points and spades. The striking thing about the work done to stabilize the ground was that the grout had reached outward as far as 125 feet from the grade of the tunnel invert. In the decayed zone, excavating exposed seams filled with hard grout varying in thickness from a sheet of paper to 15 inches.

For a good many weeks (manuscript dated August 26, 1940), underground operations have been largely concentrated on lining the several tunnel sections with concrete. The materials are obtained from a central batching plant located near Shafts 18, and are hauled from there to the different points of disposal by 6-yard transit-mixer trucks—the concrete being dropped to the bottoms of the shafts through 10-inch pipes. So far as practicable, the work has been mechanized, the main steps being: first, pouring a curb on each side of the invert; second, pouring the invert; and, third, placing the arch. The invert has an arc of 84° in the 15-foot tunnels and of 76° in the 19.5-foot tunnels—the arch constituting the remaining portion of the circular cross section. Underground, the concrete is transported by means of agitators which are mounted on the running gears of muck cars and are revolved by motors that are "plugged in" at the dumping points. During concreting, some eight or nine storage-battery locomotives are required at each shaft.

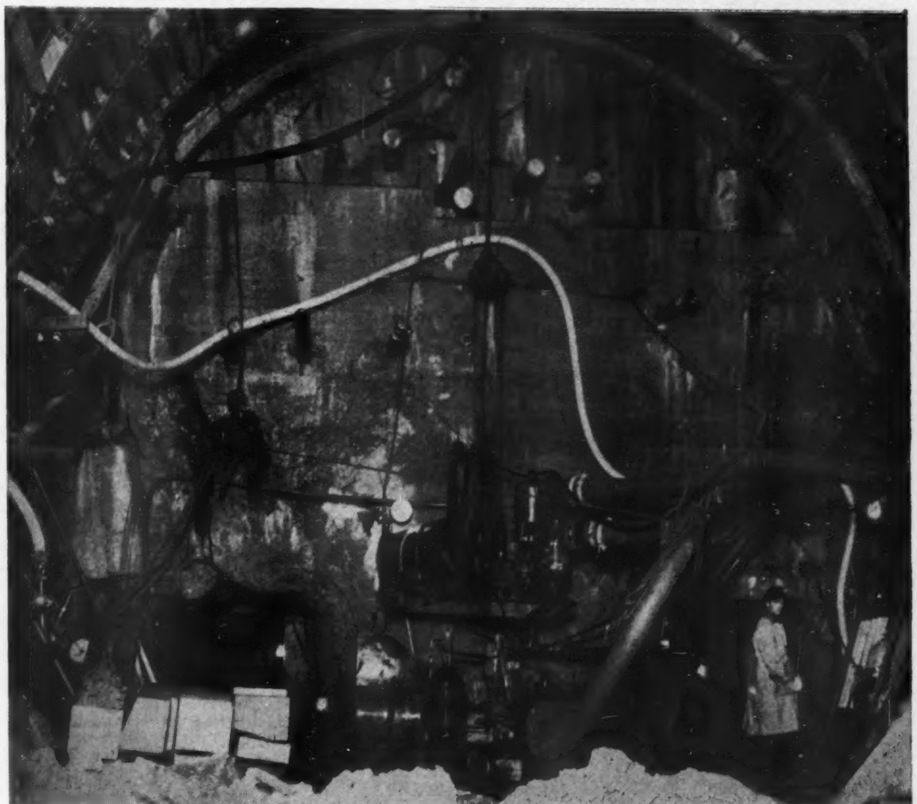
The curbs are poured to the specified elevation, and in them are set ¾-inch anchor bolts for holding the invert forms to the prescribed line. This alignment is checked by surveyors before the remainder of the lining work is completed. The forms resemble those used on highways and constitute the radial joint between the invert and the arch—the depth being equal to the minimum thickness of the concrete. The arc of the invert is shaped by a heavy screed that runs on the edges of the forms and is pulled by a slow-speed tugger hoist.



A steel bridge, 350 feet long and with a 4 per cent incline, serves to carry the agitators when pouring the invert. This structure travels on rails on the curbs (the rails are the same ones that were used in excavating the tunnel) and is moved 350 feet each day by the tugger hoist that pulls the screed. A short chute, 3 or 4 feet long, is attached to each agitator to place the concrete. After the bridge has been moved ahead, a 3-foot gauge track is laid on the invert.

Blaw-Knox telescopic, 2-hinge, steel forms are used for the arch and are made up in 20-foot sections of four 5-foot panels each. They are provided with doors for inspection, puddling, and vibrating the concrete, which is poured by means of 1-yard placers manufactured by the Pressed & Welded Products Company. In the case of the 19.5-foot tunnels two placers are mounted on a concrete jumbo, and in the 15-foot tunnels one suffices. The jumbo is mechanized so that it can lift a loaded agitator high enough to dump into the hopper over the concrete guns and permit a concrete train to pass underneath it. The carriage travels under its own power; and the ends of the concrete discharge pipes can be easily kept at the desired locations. The form-moving jumbo is equipped with four hydraulic jacks to raise or lower the 20-foot sections and also runs under its own power on a wide-gauge track that is of a length required for each stage of the operations. The arch is poured continuously five days a week. The maximum amount of concrete placed up to date in the 19.5-foot tunnel in a 24-hour day has been 2,532 cubic yards, and the average daily pour for the maximum week has totaled 2,212 cubic yards.

Although the work under Contract 306 is being pushed at three somewhat widely separated points and is of a diversified nature, still progress has been comparatively smooth, as indicated by the fact that the advance in tunnel driving at Downtake Shaft 17 was greater, measured on either a weekly or a monthly basis, than that on any other 15-foot tunnel of the Delaware Aqueduct. And the same thing is true of the 19.5-foot tunnel sections advanced from Shafts 19.



WHEN BAD GROUND WAS ENCOUNTERED

At a point 2,060 feet south of Downtake Shaft 19 a zone of badly shattered and wet ground was penetrated that called for all the patience and ingenuity at the contractors' command before it was successfully dealt with. So serious was this obstacle that 208 days were required to advance 152 feet. The line drawing is a longitudinal section through this zone showing the geological structure. A concrete bulkhead 14 feet thick was erected 28 feet back of the heading, the intervening space filled with concrete and grout, and diamond drill holes were driven through these structures and into the unstable, water-bearing section beyond. Immense quantities of grout were then forced in to solidify the decayed rock. Finally, small drifts were started at the tunnel floor on both sides to allow the placing of concrete side walls. Then two more drifts were driven immediately above them and the walls extended upward. Next a drift was excavated at the crown of the arch and, lastly, two wing drifts were driven, completing the excavation and leaving a central core of material to be removed. All told, 94,908 bags of cement were used in the grouting operations. The photograph shows the concrete bulkhead with grout pipes and water-drainage pipes protruding from it. The two lower side drifts are visible.

Associated Contractors, Inc., is a union of the Walsh Construction Company, the J.F. Shea Company, Inc., and the Henry J. Kaiser Company. The operating organization is headed by J.H. Gill, vice-president and job manager, with T.J. Walsh, Jr., assistant job manager; C.D. Riddle, chief engineer; James Small, general superintendent of surface operations; and the writer, general superintendent of underground operations. Clyde Turner is shaft superintendent at Shafts 17 and Lester Huntington is shaft superintendent at Shafts 19.

Self-Locking Tongs for Heavy Materials Handling

THAT time-honored instrument the tongs, associated in most of our minds with the iceman, has recently undergone a change that considerably alters its status in the field of materials handling. We are told that the new patented Gellert Tongs, which are being made by the Heppenstall Company, can grip, lift, and hold heavy weights without the aid of slings, etc., primarily by reason of a locking mechanism, which is their distinguishing feature. This device works automatically, and gives the craneman complete control of the loading and unloading operations. Because of this, and the fact that the groundman's only duty is that of signaling, the danger of accidents and lost time are reduced to a minimum. In a sugar mill, where these tongs are in service, they have handled 300 sacks an hour without difficulty, it is reported.

The accompanying illustrations show the general structural arrangement of the tongs and the sequence of operations during the various hoisting stages. When descending to pick up a load, Figure 1, the tongs are locked in the open position by means of a toggle pin and slot. As soon as the hoisting chain or cable hangs slack, Figure 2, the pin makes a half turn, unlocking the slot, and as the tongs come together to grip the load, Figure 3, the pantograph or linkwork opens and the pin is withdrawn. Conversely, in unloading, the pantograph starts to close as the load is released, and by the time the tongs have reached their maximum spread, ready for the next lift, the pin has made a half turn in the opposite direction and locked the slot.

The tongs are available in single and double units in a variety of designs that can be altered to handle ingots, molds, pipe, wire, bales of paper, sacks of sugar, etc. They are made of heat-treated chromium-nickel-molybdenum steel to assure strength with toughness, which, in combination with the new feature, gives them a safety factor of 3 and 4 to 1. It is claimed that Gellert Tongs have a lifting capacity of as much as 200,000 pounds and that they will save time and effort wherever materials have to be handled by means of cranes and hoists.

READY TO GO

The spread of the tongs shown at the left is sufficient to pick up the two coils of steel. This particular installation can handle a maximum load of 20,000 pounds, although lifting capacities run as high as 200,000 pounds. Figures I, II, and III are described in the accompanying text and graphically show the structural features of the tongs and what happens from start to finish of the hoisting operation. The type eliminates the use of chains and slings, thus contributing considerably to the safety of the ground men. The drawing is reproduced by courtesy of "Inco."

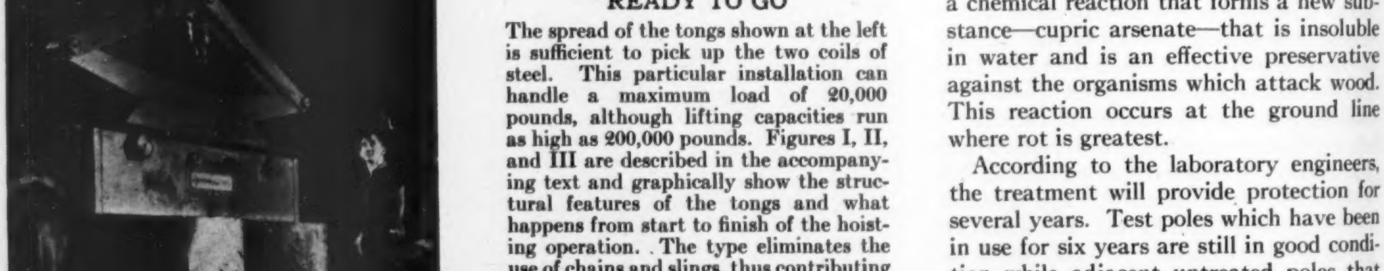


Fig. I Fig. II Fig. III

Protective Treatment for Green Poles

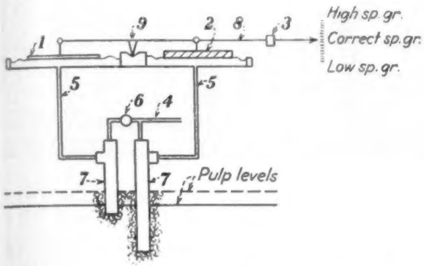
EXPERIMENTS carried out at the Forest Products Laboratories of the Canadian Department of Mines and Resources have resulted in the development of what is reported to be an effective treatment for the preservation of telephone and power-line poles in remote regions. Holes are bored lengthwise in the butts of the poles near the circumference and are filled alternately with copper sulphate and sodium arsenate. The bark is left on the end up to the ground line, and the poles are treated and planted as soon after cutting as possible.

Evaporation of the moisture from the tops of the poles draws the preservatives from the butts up to the sapwood, where they meet. Both chemicals used are soluble in water, and when combined set up a chemical reaction that forms a new substance—cupric arsenate—that is insoluble in water and is an effective preservative against the organisms which attack wood. This reaction occurs at the ground line where rot is greatest.

According to the laboratory engineers, the treatment will provide protection for several years. Test poles which have been in use for six years are still in good condition while adjacent untreated poles that were put up at the same time are decayed at the ground level.

Controller Maintains Density of Pulp in Grinding Ore

IN CRUSHING ore, it is essential for efficient operation that the density of the pulp be maintained, and to this end it is the practice to take samples regularly to make up any deficiency. This is generally done by hand, a more or less hit-and-miss method that has its shortcomings. It is therefore of interest to learn that an automatic pulp-density controller has been developed that is sensitive to any change



From Mining and Metallurgy

PULP CONTROLLER

When the scale beam, 9, is in equilibrium, the density or specific gravity of the pulp is correct, as indicated at the right in this sketch, but when it is thrown out of balance it is either high or low and the dilution water or other constituent is automatically regulated accordingly.

in specific gravity and promptly restores it to normal. The mechanism was described in a paper presented at the last annual meeting of the American Institute of Mechanical Engineers, and consists essentially of means, first, for continuously weighing the pressure differential between two points at fixed levels below the surface of the pulp, and, second, for controlling the supply of water or other constituent fed to the pulp. The arrangement is shown in the accompanying sketch.

Two air-pressure bells, *7*, are mounted vertically in a fixed position on the framework of the pulp container with the open end of one projecting farther down into the pulp than the other. At the top the bells are closed except for connection *4* through which low-pressure air is forced, the pulp being prevented from rising into the bells by equalizer valve *6*. Through pipe *5* the bells are linked with independent airtight chambers which are covered with flexible diaphragms carrying plates *1* and *2*. The diaphragms, in turn, are connected with opposite ends of a scale beam or balance, *9*, the indicating arm *8* of which, provided with a sliding weight, *3*, governs the action of a motor-operated valve that regulates the flow of dilution water in the case of a classifier, of a diaphragm pump for thickener control, or the admission of the heavy make-up medium in the sink-and-float process.

Accurate functioning of the automatic density controller depends primarily on the placing of the pressure bells in a representative body of pulp. It is reported that in a closed circuit consisting of a No. 66 Marcy mill and of a 4-foot Dorr classifier, the device maintained the solids within 0.5 per cent of the required point under normal operating conditions, and when the circuit was considerably interrupted by cutting the ore feed off and on, the variation did not exceed 2 per cent. In the sink-and-float process, where the make-up medium was required to have a specific gravity of 2.65, control within 0.01 per cent either way has been maintained by means of it.

Cooling Tower in Unusual Setting

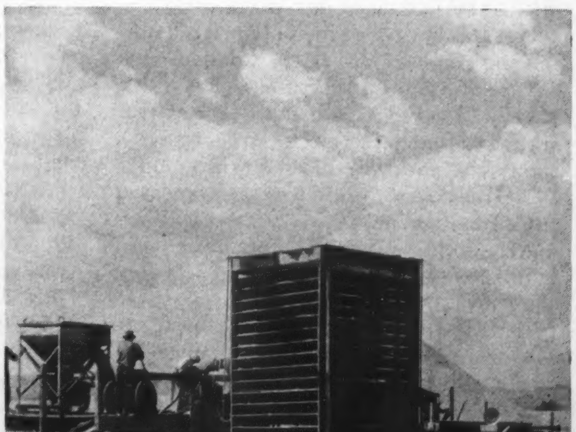
IN CONSTRUCTING a section of the 130-mile Coachella Canal, a branch of the All-American Canal in southern California, the contractor is using a piece of equipment that usually does not play a part in concreting operations. The region traversed is a hot and arid one, and the U.S. Bureau of Reclamation, for whom the work is being done, has specified that "no concrete is to be deposited which has a temperature of more than 90°F., and that concreting will not be permitted during the period from June 1 to September 30 each year."

This presented something of a problem, because all the water required for mixing concrete for structures along the Coachella Canal has to be delivered through pipes that lie on the surface of the ground where they are exposed to the rays of the desert sun. The water is pumped a distance of 7,500 feet from the nearest irrigation lateral to a point on the canal where it is stored in tanks or natural reservoirs. From there it is conveyed to the respective sites through another pipe line paralleling the canal. From the source to the farthest point of use it travels 58,000 feet—nearly 11 miles.

With this system it became impossible, even early in April, to live up to the Government requirements, so the contractor decided to do his concrete work at night. But that, too, had its disadvantages. It was then that the cooling tower was built which is now in service and which lowers the temperature of the water sufficiently to supply concrete as specified. The tower is of the evaporative type, and has sides made of 1x6-inch slats sloping toward the center to prevent loss of water and to provide for its diffusion as it falls from the top to the storage tank at the base. To obtain an even distribution throughout the entire cross section of the structure, the water enters by way of perforated pipes and, as it makes the 10-foot drop, passes through 1/4-inch mesh screens placed on 2-foot centers.

The flow of water into the tower is controlled by a float valve in its storage tank. In the event concrete pouring is interrupted or retarded, the float rises and automatically closes the valve in the supply line. A 1 1/2-inch pump mounted on the base serves to recirculate the water from the tank through the tower as often as possible to obtain maximum cooling; and by means of a 2-way valve in the discharge line of the pump the water either can be delivered to the mixer or recirculated between batches for further cooling. It passes over the tower an average of two times when the mixer is operating at normal capacity. Observations during concrete placing have shown that the temperature of the water in the supply line has registered as high as 125°F. and that of the water leaving the tower as low as 68°. The low relative humidity prevailing in the locality has contributed greatly to the effectiveness of the cooling tower.

We are indebted to the U.S. Bureau of Reclamation for the description of the cooling tower.



Courtesy, U. S. Bureau of Reclamation

CONCRETING OPERATIONS

The portable cooling tower shown in this picture is in use on a section of the Coachella Canal that traverses desert country in southern California and serves to lower the temperature of the water used for mixing concrete. The storage tank at the base of the structure has a capacity of 220 gallons, which is sufficient to keep a 1-yard paving mixer, operating at maximum capacity, supplied with water. The usual rate of pouring is from 12 to 15 yards an hour.

WEATHER CHANGES

ARE our winters getting milder? Is there something to the claim of the oldsters that Jack Frost used to crack down harder than he does now? The weather bureau says "yes." Statistics show that winters are getting shorter and summers longer. This is a general trend and there are exceptions in individual years.

The longest weather records in this country, dating in some instances from the latter part of the eighteenth century, disclose that there has been a decided inclination towards higher average annual temperatures since about the middle of the nineteenth century. This has been especially marked during the past few decades. Evidence that the trend has been general is found in the Reseau Mondial records from 400 weather stations around the globe. These figures show that during the 22 years from 1910 to 1931, inclusive, world temperatures were subnormal in only two years, approximately normal in three, and above normal in all the others. Normal temperatures of the U.S. Weather Bureau are based on the period 1875-1921, which includes relatively low temperatures in the first part and relatively high ones in the last part.

This climatic trend coincides with a period of recession of the world's glaciers, as was recorded in the 1939 volume of the *Transactions of the American Geophysical Union*. The report is based on measurements and observations of glaciers that have been carried on since 1580 in some areas and for lesser periods in others, and shows that an epoch of glacier extension began about 1600. It lasted for some 250 years, and was accompanied by subnormal temperatures. In the middle of the last century, the glaciers started receding towards the positions they occupied near the end of the sixteenth century, and a balmier climate ensued.

The higher temperatures are of considerable economic significance, especially to farmers. For example, the growing season in southeastern Iowa, representing the interval between killing spring and fall frosts, averaged 194 days in the decade 1925-35, as compared with 174 days in the decade 1890-1900. In the vicinity of Washington, D.C., the growing season is now about 30 days longer than it was in 1906, and the winter temperature during the past ten years has been about the same as it was in south-central Virginia some 40 years ago.

AIDS FOR HOUSEBUILDERS

IN the first issue of this magazine, published nearly 45 years ago, it was said of compressed air: "Its scope of usefulness is each day widening, and its possibilities are beyond conjecture." The statement was true then, and it is scarcely less true now. For, despite the widespread application of compressed air in diversified fields, and its indispensable position in many of them, new uses for it are being found continually.

Every large-scale building or construction undertaking employs air power in many ways, yet the same savings and labor-lightening benefits are not being realized in the field of lighter construction. Contractors on tunnels, bridges, dams, highways, skyscrapers, and kindred projects are air-minded. Their bids are figured on cost estimates based on the use of compressed-air equipment, and they would be prohibitively high if this medium of power transmission were not available to them. In lesser degree, but still to an important extent, air-operated tools and machines can be profitably utilized by the small-scale builder. As was pointed out in a recent article in *The American Builder*, "Cost studies indicate that the scientific and intelligent use of compressed-air equipment by building contractors in the residential and light-load-bearing field may bring about just as important economies and time-saving results as in the heavier works field."

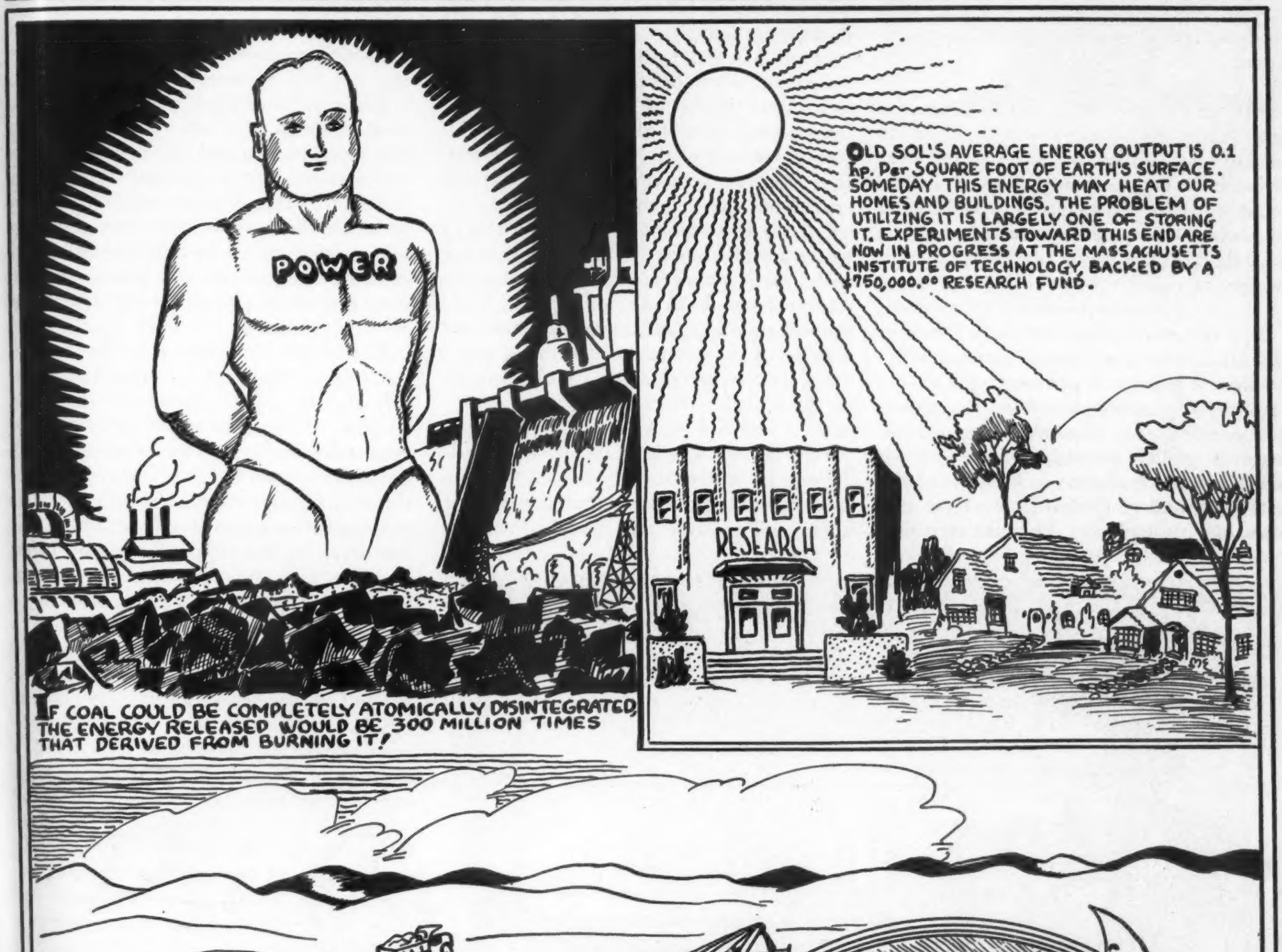
Air-powered tools already on the market, or easily obtainable by adapting existing models, can be beneficially employed for substantially all operations involved in rearing a house or an apartment building, starting with the digging of the foundation and continuing through subsequent steps. Scraper hoists, rock drills, paving breakers, and spades are available for handling any kind of subsoil with dispatch; backfill tampers will best consolidate earth around walls or in sewer trenches; and air-driven pumps will quickly dewater excavations flooded by heavy rains. Stone-cutting tools will speed up masonry jobs, and pneumatic vibrators will produce better concrete work. For the carpenter's aid, there are pneumatic safety saws, wood borers, and planes. An air-operated hoist will elevate timbers, bricks, and other heavy materials quickly and safely. Pneumatic wire brushes and the sandblast will clean surfaces prior to applying stucco. Light rock drills will save time in putting holes through masonry walls for wiring or piping. The paint-spray gun is already widely used. A pneumatic screw driver is available, and an air-operated plastering machine has been developed and given practical tests. Stucco is ordinarily applied with a "cement gun," and insulating materials such as rock wool are blown into place with air.

In general, anything that is now done with electric tools in this field can be done with air tools, and some work that electric tools cannot perform can be done with air tools. Where there is a choice between the two, air tools are lighter and easier to handle. All the equipment mentioned can be operated by a small portable compressor. It just has to be moved to the job and is ready to go to work, whereas time is required to run in electric lines.

Right now would appear to be an appropriate time for contractors to investigate the economy and time-saving advantages of compressed-air equipment. Last year new home construction was ten times greater than in 1934. The building program has momentum and will continue to gain if homes can be provided at a price people can pay. Costs are already rising, however, and anything that will tend to counteract that trend will promote construction.

FEATS & FACTS

by ROBERT GLUECK



Industrial Notes

Portable-lamp extension cords that have a habit of kinking and getting in the way can be kept neatly reeled by means of a retriever that is suspended above the work-table.

Master Fortifier is the trade name of a new liquid for foundry use. Added to shellac and applied to patterns and core boxes it is said to make them moisture-proof, to protect them from abrasion, and to prevent the sand from sticking. It is available for mixing or ready-mixed in a variety of colors.

It is reported by the American commercial attache in Oslo that a Norwegian hydroelectric plant is experimenting with the recovery of potash salts from sea water. The company has discovered that certain reagents yield extremely soluble potash salts, permitting direct precipitation of the potash content of the sea in the form of a filterable compound. This intermediate product must be treated for the recovery of the reagents. Further information about the process is being withheld until the patents are issued.

Among the new developments announced at a recent meeting of the American Chemical Society is one of more than usual significance because of its wide-reaching effect. It is an antiseptic paint for the use of nurseries, hospitals, and damp places like breweries where molds and yeasts are likely to do harmful work. The paint is made with a little chlorine or iodine, and is the result of much experimentation. It is claimed to kill typhoid and other germs for a period of nine weeks and to retain a measure of its destructive power after it has been on the walls for six years.

An improvement in metal-spray guns is announced by Dr. M.U. Schoop of Switzerland who introduced his first gun of this kind in 1909. In the new unit the metal, in the form of wire, is melted by the aid of a small luminous arc instead of an oxyacetylene flame. This results in a temperature of 7,232°F. and permits the use of metals with high melting points.

Holes and nails are dispensed with in two new methods of slate roof construction developed in England. In one case all the roof members are of steel and the slates are fastened to them by special clips. In the other the slates are held in a metal grillage that is said to be an improvement over separate steel angles and slats in that it gives greater rigidity to the roof as a whole.

Within the past year a variety of materials, including a plastic fiber and bits of soft wire, have been offered as a substitute for steel rods in reinforcing concrete. The newest is glass in the form of strips, and is proposed by two architects who claim that it has advantages over steel. The surfaces of the glass are rough; and it is claimed that the alkali in the concrete slightly affects the glass with the result that the two materials are virtually welded together a month or so after placing.

As a partway solution of the traffic problem in Los Angeles, Calif., it is proposed to build a monorail system from the downtown section of the city to Hollywood, a distance of 6½ miles. The tentative plans call for cars suspended from a single rail supported by columns placed in the center of Wilshire Boulevard at 100-foot intervals. It is estimated that such an elevated line could carry 15,000 passengers each way daily. The estimated cost of the project is $3,000,000.

The United States Rubber Company, which claims to have introduced conveyor belts of 42-ounce duck, is now offering 9-ply, 48-ounce belting of this kind. The latter, we are informed, can take safely 60 pounds strain per inch per ply, or one-third more than the lighter-weight belt, making possible single-unit installations of greater length, lift, and tonnage. The first of the type now in service is 1,530 feet long and 54 inches wide and carries 1,000 tons of run-of-mine coal hourly at a speed of 350 feet per minute. The material is fed on to the belt from an underground hopper, and in its travel up a 16.5° slope to the preparation plant is raised a matter of 206 feet. It is said to be the longest single-unit, slope conveyor belt in use.

Among the unusual organizations in New York City is one called The Moles. It is composed of men now or formerly engaged in tunnel, subway, sewer, foundation, marine or subaqueous, or other heavy work. It was organized in 1936 and has approximately 200 members. It awards a

MADE TO FIT

It takes no trained man to build partitions of exceptional beauty with these special glass blocks and prefabricated members of architectural bronze made jointly by the Pittsburgh Corning Corporation and Revere Copper & Brass, Inc. The extruded shapes that constitute the framework are strong, interlocking, and self-aligning and take and hold firmly blocks of either 8x8 or 12x12 inches. Because of their ornamental value and the fact that they are just as easy to take down and rearrange as to put up, walls of this type are especially suitable for office buildings, stores, and exhibition halls where changing tenants and displays necessitate frequent remodeling.

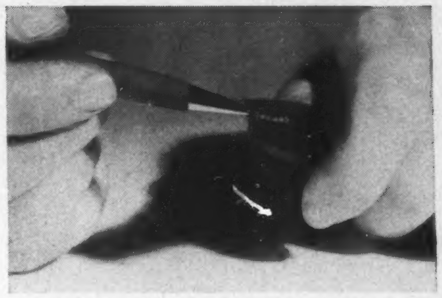
certificate and plaque annually for outstanding merit in its construction field. The chief summer social event is a clambake at which the members and their guests compete in strange athletic contests befitting their vocations. One of the featured competitions this year was a dirt-moving contest in which eight 2-men teams took part—one member shoveling half a cubic yard of sand into a wheelbarrow and his partner wheeling it a stipulated distance. Spike-driving was another peculiar sport indulged in.

Usalite is the name of a new flashlight with a swivel head containing the lamp, lens and reflector, permitting the light to be focused at any angle within an arc of 180°. Added features are an unbreakable plastic lens, a metal pocket clip, and a snap-back hanger. It is sold under the name of Swivel-Head.

Silvering mirrors by mechanical means is an innovation that has lately been introduced in the United States. The work is done by the use of a special spray gun with two nozzles supplied from overhead containers with an ammonical silver-nitrate solution and a reducing agent, respectively. The fluids are forced through the nozzles and atomized upon emerging by means of compressed air, the two mist-like sprays coming together about 7 inches beyond the lips of the nozzles. The instant they meet and mix, the silver begins to precipitate and is deposited on the glass at the rate of 12 square feet in less than a minute, it is claimed. Aside from doing the work at much greater speed, the film is said to be tougher and more uniform and lustrous than that obtained by the usual method.

Felted wood fiber and flakes of vermiculite have been used to make a fire-resisting material by the Fire-Tex Insulating Board Company. It comes in panels 48 inches long, 18 inches wide, and ½ inch thick, and, according to a report by the Underwriters, has checked the spread of fire from one part of a structure to another for one hour when placed on both sides of wood studding and coated with gypsum plaster reinforced with wire netting.

What is believed to be the first V-belt ever made to prevent accumulation of static and to retain its static-discharging qualities during its service life has been announced by The B. F. Goodrich Company. The development is of especial interest to manufacturers and users of domestic appliances such as washing machines, of gasoline pumps and other service-station equipment, as well as of machinery in chemical, powder, and milling plants where static discharges might create a fire hazard. It is



further claimed that it will not act as a "short" between the motor and its operator because sufficient resistance has been built into it to check the passage of current. For the present the new belt will be sold only to machine or equipment makers.

For heating aluminum rivets, used extensively in the manufacture of airplanes, the American Car & Foundry Company has designed a furnace that will take 24 rivets of any size ranging in diameter from ⅛ to 1⅛ inches and in length up to 4 inches. The rivets are inserted horizontally into V-shaped slots on both sides of the unit, which is heated electrically and arranged so that it can be set for any temperature up to 1,000°F. It is claimed that the furnace will heat 24 rivets to 400° in approximately three minutes or to 950° in about four minutes, and then keep them within 5° above or below that temperature.